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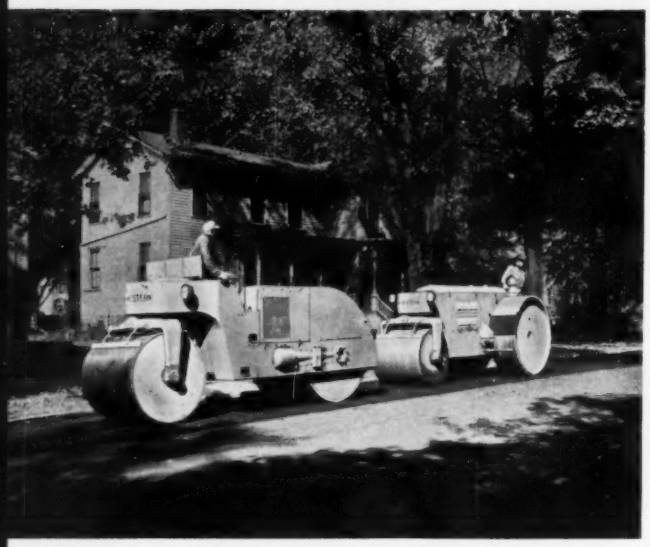

In this new series of Rollers . . . by America's first builder of motor rollers . . . all that is latest and best in engineering techniques and skills is combined with highest standards of construction to produce a truly fine product. With gasoline or diesel engines . . . dry clutch or torque converter drives . . . two-speed or four-speed transmissions, and drum-type front and rear rolls for water or sand ballast, these Rollers perform in a manner that will satisfy the most critical owner or operator . . . engineer or inspector. Your nearby A-W distributor will be glad to tell you the whole story. Austin-Western Works, Construction Equipment Division, Baldwin-Lima-Hamilton Corporation, Aurora, Illinois.

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Tandem Rollers range in weight from 5 to 14 tons. Each is available with gasoline or diesel engine, and optional torque converter drive.

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New Chemical Center Specifies CLAY PIPE for Sewerage System

CALVERT CITY, KY. recently installed 87,000 feet of Vitrified Clay Pipe as the initial project in the town's fast-growing sewerage system. In recent years, Calvert City has put itself on the industrial map by attracting a group of large chemical industries and establishing a new major chemical center. So far, $30 million has been invested in plants, with $9 million more committed for construction. Population has jumped from 400 to 1,000, and is expected to hit 10,000 within the next 10 years. When the need for a modern sewerage system became apparent, city officials realized that they had an opportunity to "do the job right" from the very beginning. Wisely, they specified Vitrified Clay Pipe.

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Progress in Public Health - Through Clay Pipe Research

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JULY 1956
VOL. 26 • NO. 7

THE MAGAZINE OF ENGINEERED CONSTRUCTION

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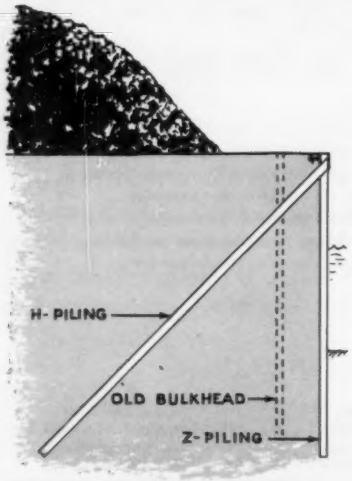
New bulkhead at Long Island Lighting Company's Glenwood Landing, L. I., coal dock. Piling contractor was J. Rich Steers, Inc., New York. After installation, tension piles were cut flush with Z-Pile bulkhead and capped with a plate. Bethlehem supplied the Z- and H-Piles.

Steel-pile bulkhead at coal storage dock installed without moving coal piles



Tension-pile anchorage was used because coal pile could not be moved to install conventional tie-rod anchorage.

When the old dock front at Long Island Lighting Company's Glenwood Landing coal pier had to be replaced with a new Z-Piling bulkhead, it was impossible to interrupt the utility company's operations for the length of time necessary to move the coal pile. The contractor was therefore unable to install a bulkhead with a conventional tie-rod anchorage.

The solution was to use a tension-pile anchorage with 60-ft H-Piles driven at a 45-deg angle between alternate pairs of Z-Piles along the 300-ft frontage. The Z-Piles used in the bulkhead are 44 ft long, have a 14-ft freeboard, and were driven in approximately 15 ft of water. In driving the H-Piles, the hammer was held at a 45-deg angle by coaxial cables. After driving to refusal in sand, the H-Piles were cut off and capped with a plate flush with the bulkhead.

Bethlehem supplied 170 lengths of Z-Piling for the new bulkhead, as well as the H-Piles for the tension anchorage.

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We invite you to tell us about any structural project, contemplated or in the works, in which we might be of practical assistance. Bridge Department, John A. Roebling's Sons Corporation, Trenton 2, N. J.

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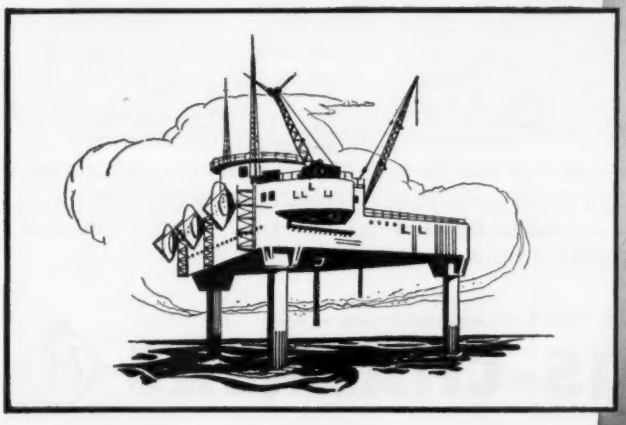

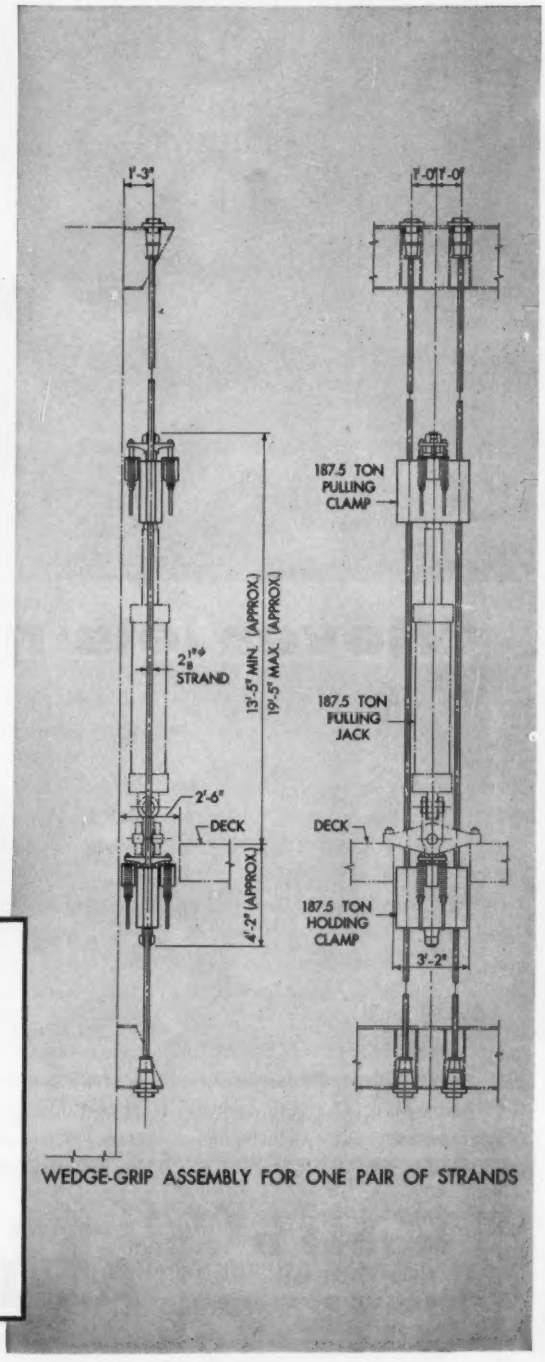

WEDGE-GRIP ASSEMBLY FOR ONE PAIR OF STRANDS

"Never lets me down"

says Everett Datton, San Antonio, Texas, about the Allis-Chalmers Model D Motor Grader.

It's two homes a day, out Texas way—as Quincy Lee Construction Company works on a big-scale project of building 1400 new homes in two years.

One of the machines on the job is an Allis-Chalmers Model D motor grader used to grade roads, landscape homes and build driveways. Owner Quincy Lee says this about his Model D: "I'm very happy with it. It does a very fine job for us." Operator Everett Datton says,

"I like the Model D. It gets in and out of tight spots, especially where buildings are close together. With the D's fine control I can work between newly-planted trees and close to sidewalks without damaging trees or chipping cement. Not only is this machine good at fine grading, but its diesel engine has plenty of power for handling full capacity loads. I run it 9 hours a day, 5½ days a week. *She never lets me down.*"

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Quincy Lee and Everett Datton are confirming what thousands of other Model D operators and owners know. In its class, you just can't beat the D for sure-fire performance at low cost. Watch it in action and you'll be amazed how the D's right combination of weight, power and traction lets it handle a wide range of jobs. And you can choose either diesel or gasoline engine models, plus number of attachments—including rear-mounted ⅜-yd loader and midship-mounted hydraulic scarifier, to increase the Model D's usefulness and efficiency.

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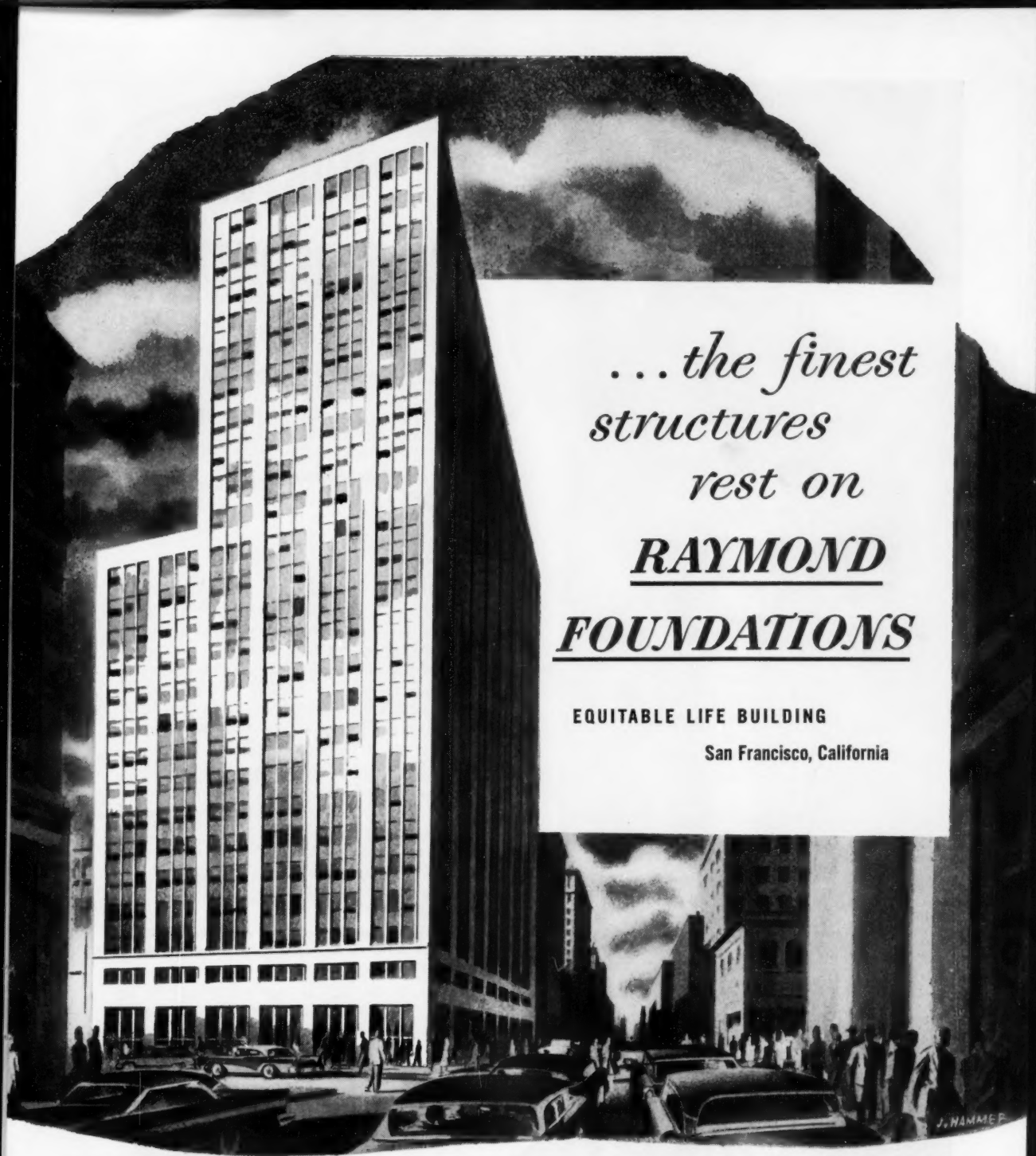

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The attractive Horton Waterspheroid provides a dependable gravity pressure water supply that is available day or night to meet normal or emergency water needs. Further information on the Waterspheroid, or other Horton® elevated tanks, may be obtained by writing our nearest office.

500,000-gal. Horton Waterspheroid at Northbrook, Ill. It is 135 ft. to the top of the water line and the spheroid is 55 ft. 6 in. in diam.

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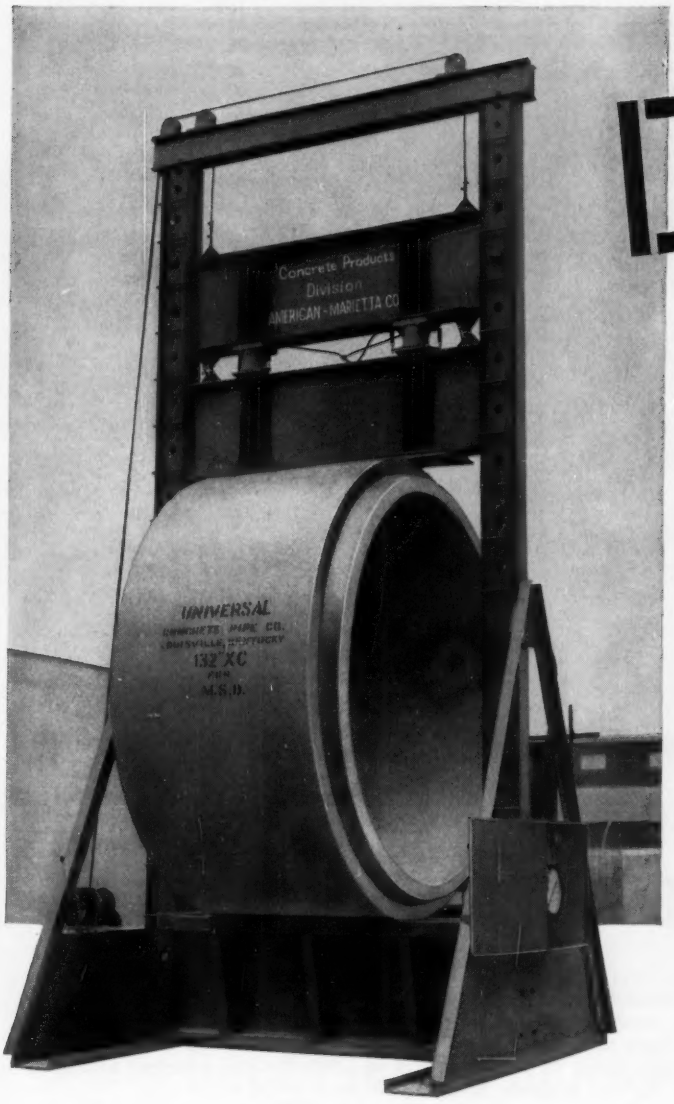

Pipe section under test is 132″ in diameter, six feet long, with a 12″ wall thickness.

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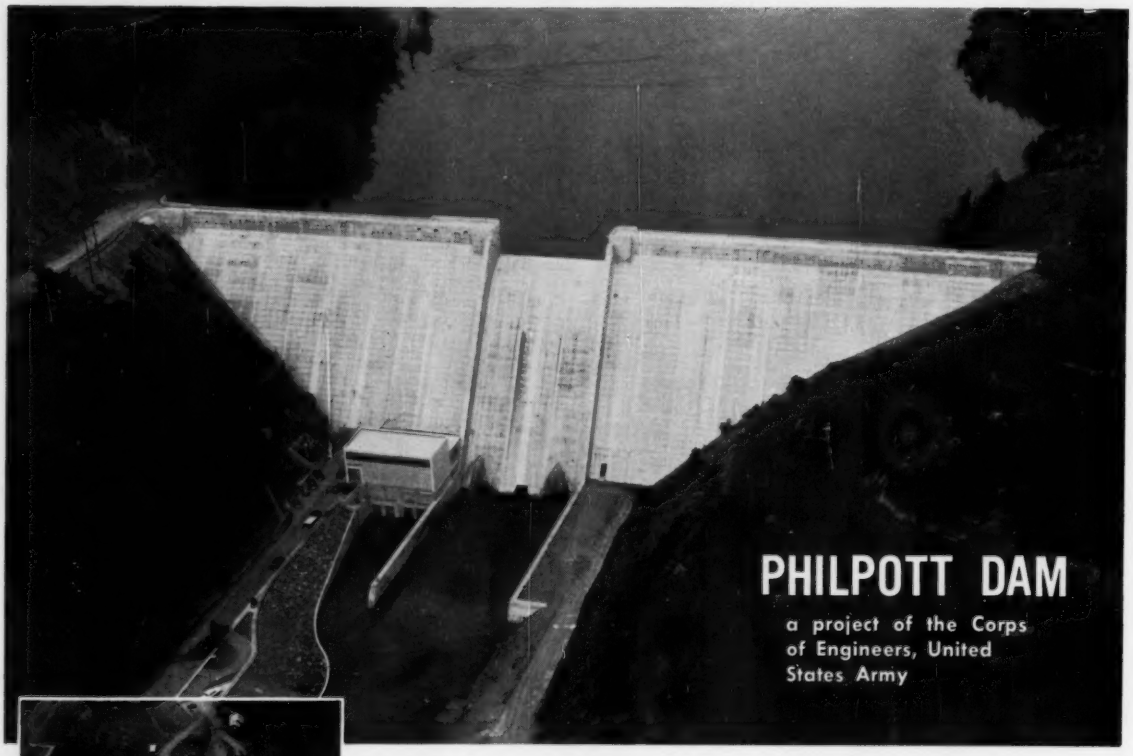

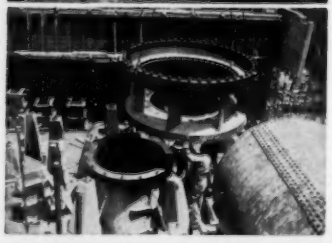

Another Outstanding Installation of **Leffel Hydraulic Turbines**

Philpott Dam, a recent Corps of Engineers, United States Army, project on the Smith River in Henry and Franklin Counties, Virginia, is a site of another outstanding installation of efficient dependable Leffel turbines. The Philpott project was constructed for flood control and hydroelectric power generation. It is one unit of a comprehensive reservoir system planned for the Roanoke River basin.

Three Leffel turbines were installed at the Philpott power plant. Two are each rated at 9400 hp under 152 ft. net head, at a speed of 227 rpm; and the third is rated 860 hp at 720 rpm.

The view above shows the completed project. The views at the left show the project under construction, the spiral casing for one turbine in place, and a stay ring being lowered into place over the draft tube.

Other Leffel installations are dependably and efficiently producing power from water in this country and in all parts of the world. Leffel engineers are waiting to put their 94 years of experience with water power to work for you, whether your project is a completely new installation, or an expansion or rehabilitation of existing facilities. Write today for literature describing Leffel turbines for all hydraulic power requirements and showing a wide variety of outstanding Leffel installations.

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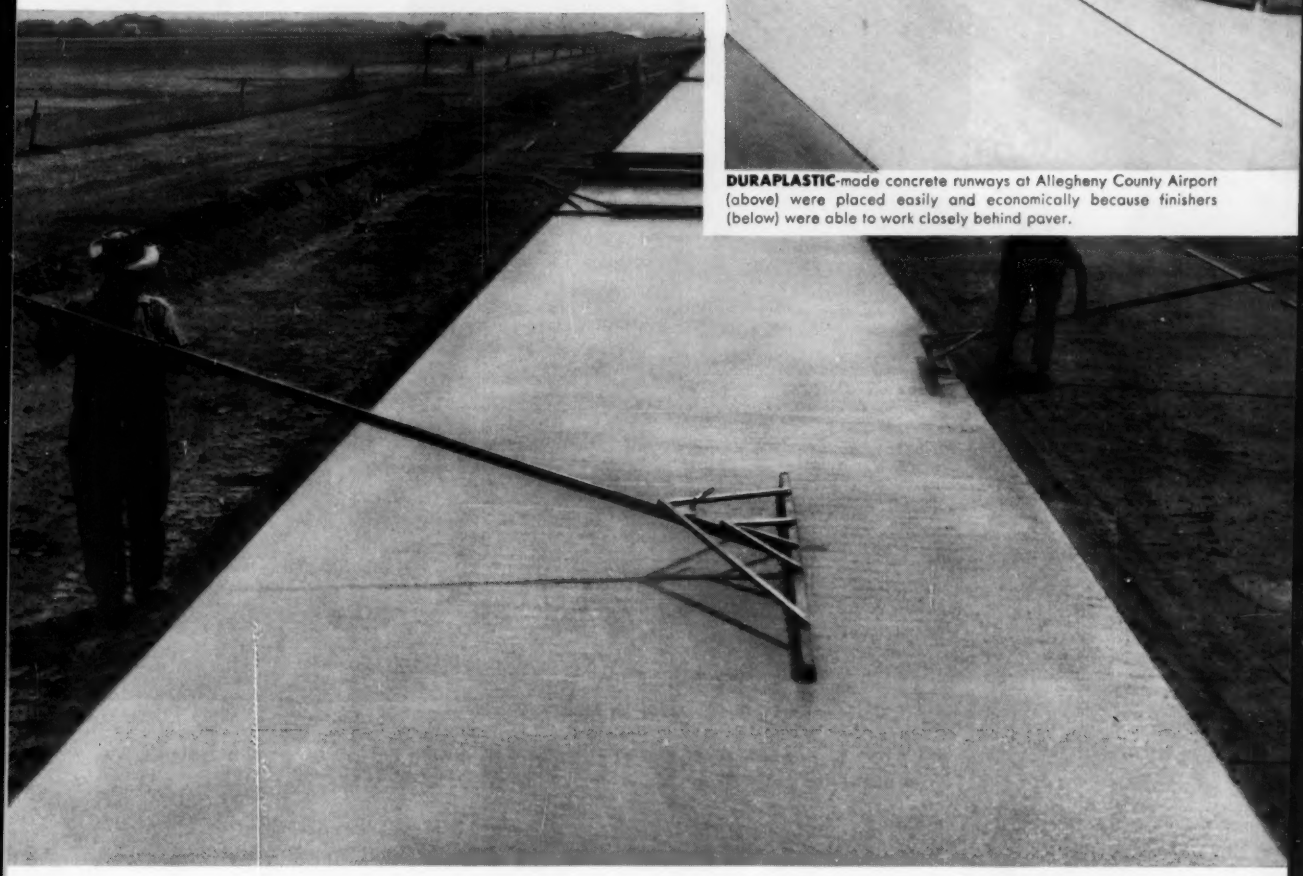
DURAPLASTIC-made concrete runways at Allegheny County Airport (above) were placed easily and economically because finishers (below) were able to work closely behind paver.



Because Duraplastic* minimizes bleeding and segregation

"For a fast paving job on the lengthy Allegheny County Airport runways, we used Atlas Duraplastic cement for better workability and placeability," says Mr. Anthony A. Benintend, Vice President, Ben Construction Co., Pittsburgh, Pa.

Mr. Benintend and many other contractors have found out for themselves that Atlas Duraplastic air-entraining portland cement minimizes bleeding and segregation in concrete mixes, allowing finishers to work closely behind the paver. And, with Duraplastic, the finished concrete is fortified against the effects of freezing-thawing weather and scaling caused by de-icing salts, and provides greater durability.

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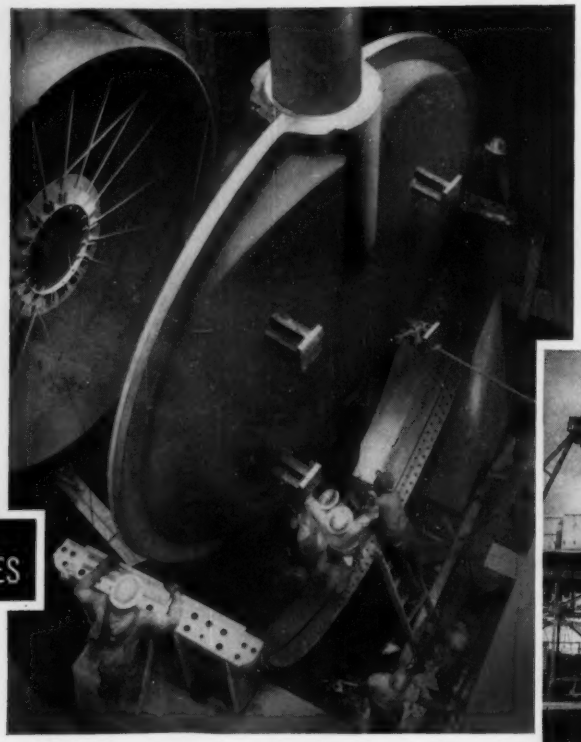
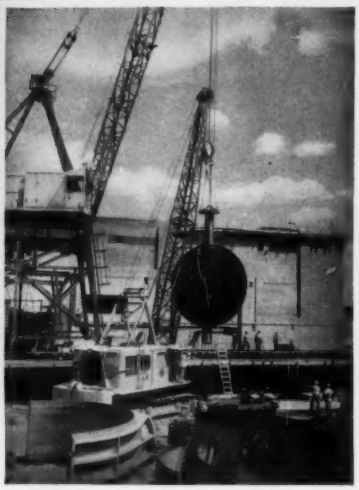


An 18' butterfly valve disc is shown here during installation at Blakely Mountain in Arkansas. Note the streamlining of the welded disc.

Photos—Vicksburg District, Corps of Engineers



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SMS VALVE SEALS CUT LEAKAGE TO MINIMUM

SMS Butterfly Valve seals cut leakage to a minimum. Disc seals are adjustable from either inside or outside, whichever is specified. Specially-developed SMS trunnion seals are essentially drop-tight.

With inside adjustment, the disc may be seated directly on the plate steel housing, as at Blakely Mountain, illustrated above, and as at Fort Peck, Montana. Here a 16 ft. dia. valve, recently tested after 14 years of service, had *less than ½ gpm leakage*.

SMS welded discs and housings assure greater freedom from the material defects of castings and permit more economical construction. The photo illustrates the streamlining possible with welded steel plate construction. This holds head losses and turbulence to a minimum.

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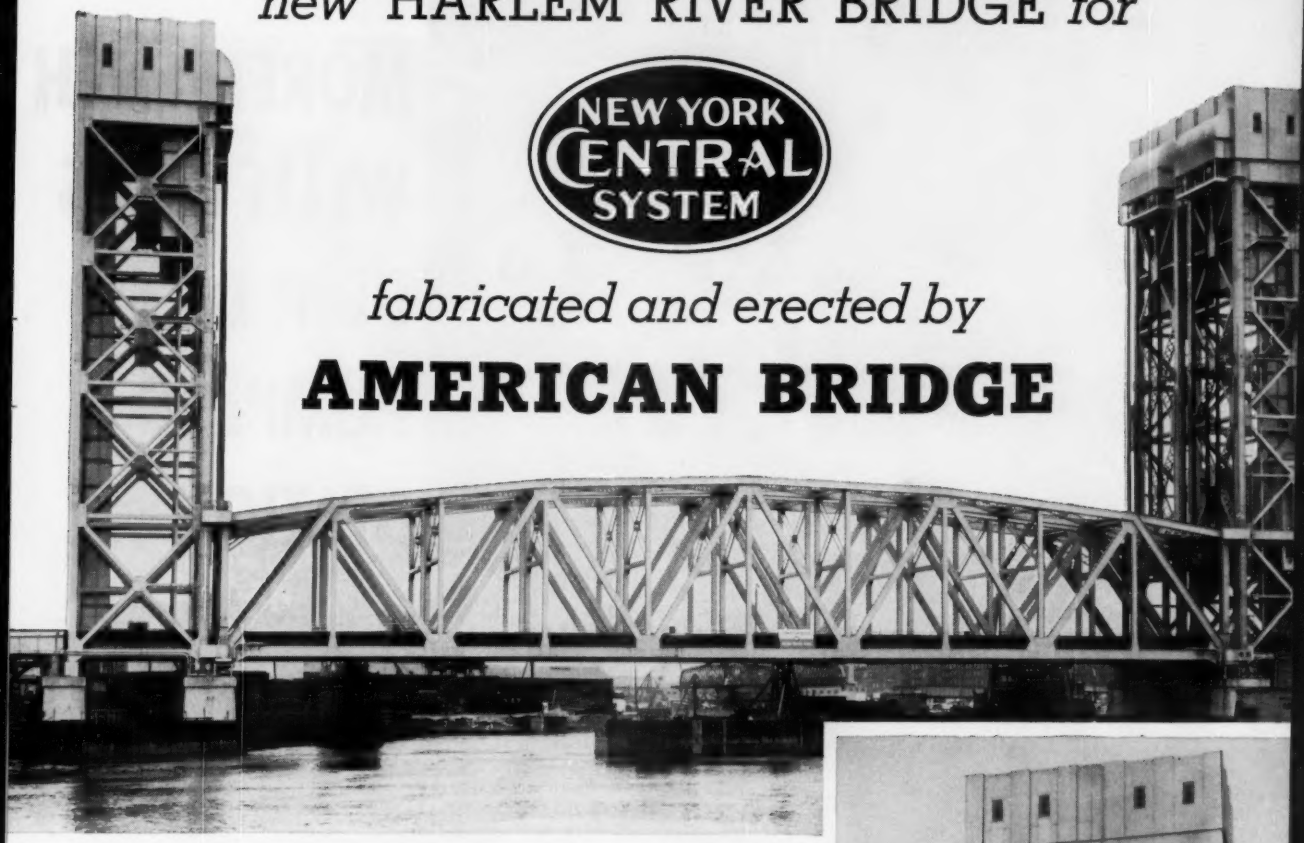
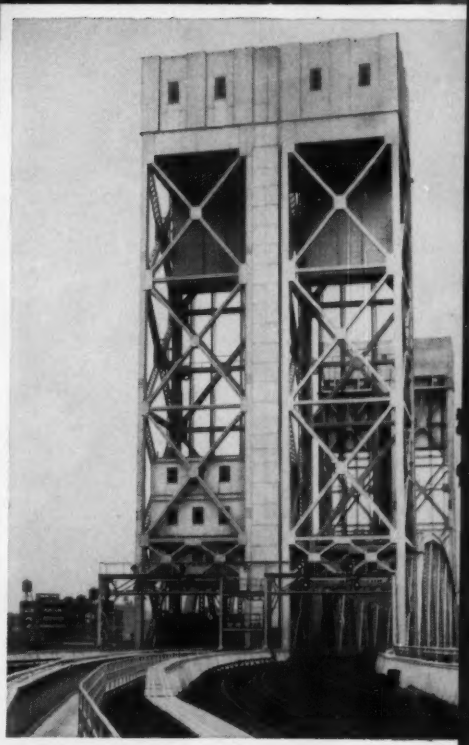




1,772-ft. structure features parallel double-track vertical lift spans —

Replacing an old thru truss swing bridge built about 1895, New York Central's new Harlem River Bridge is as modern as you'll find anywhere.

1,772 ft. between abutments, it is a four-track, 28-span structure composed of: two duplicate, parallel, double-track Thru Warren Truss Vertical Lift Spans, 340 ft. long; four duplicate, double-track Tower Spans, 40′ long x 33′ wide x 200′ high—two for each lift span; fifteen 4-track Thru Plate Girder Spans, 38′ - 9″ to 84′ - 2″ long, for South Approach; fourteen double-track Deck Plate Girder Spans—six 61′, and eight 54′—for seven-span North Approach; three 4-track Beam Spans—11′, 19′, and 24′—forming the decks of three intermediate piers in North Approach.

The lift spans are 33′ wide and 11′ apart, center-to-center of inside trusses. Trusses are 40′ to 55′ deep. Each lift span contains 1,280 tons of structural steel and has a lift of 110′, from 25′ above water in lowered position to 135′ above water when raised. Each lift span is raised by means of 64 wire ropes riding on eight main counter-weight sheaves 15′ - 6″ in diameter.

American Bridge fabricated and erected the 13,670 tons of structural steel for this modern bridge and dismantled the existing structure. The New York Central Railroad designed the lift spans and approaches. Hardesty & Hanover designed the Tower Spans and Lifting Machinery.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION • GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

Contracting Offices in: AMBRIDGE • ATLANTA • BALTIMORE • BIRMINGHAM • BOSTON • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DENVER • DETROIT • ELMIRA • GARY HOUSTON • LOS ANGELES • MEMPHIS • MINNEAPOLIS • NEW YORK • ORANGE, TEXAS • PHILADELPHIA • PITTSBURGH • PORTLAND, ORE. • ROANOKE • ST. LOUIS • SAN FRANCISCO • TRENTON

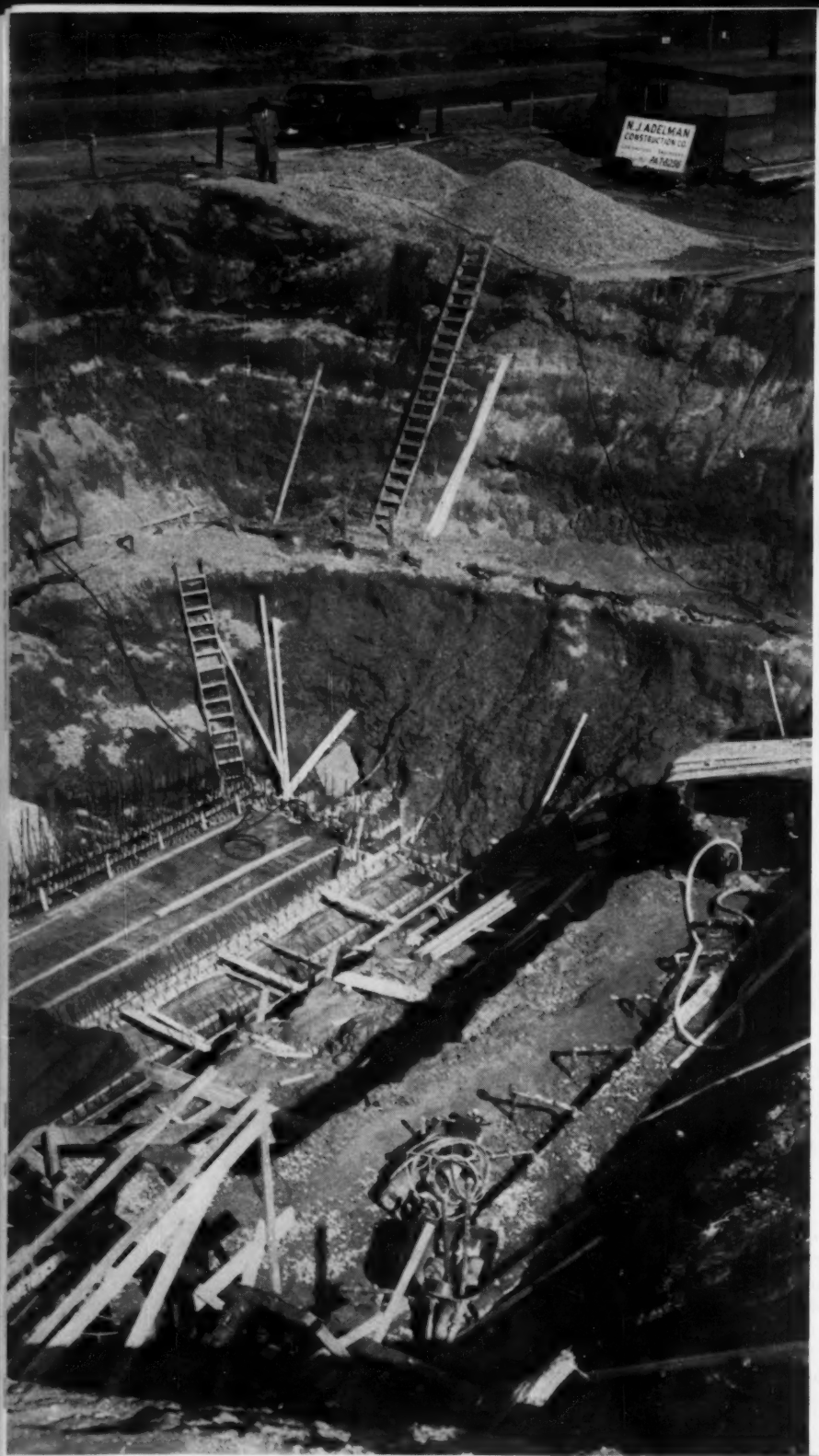
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

AMERICAN BRIDGE

INTERESTING MOTION PICTURES AVAILABLE—"Building for the Nations" and "The Suspension Bridge," two entertaining and educational films, are now available without charge to business, fraternal and civic organizations, churches, schools and colleges. Write to Pittsburgh office for bookings.

UNITED STATES STEEL



MORETRENCH WELLPOINTS DEEP DRY PUMPING STATION

in Natick, Mass.

Never underestimate a woman's common sense!

Natalie Adelman, N. J. Adelman Const. Co., knows that the best way to control 17′ of water in clayey sand is to do it with a Moretrench Wellpoint System.

Pumping started on Monday afternoon. Wednesday morning, they were excavating—

IN THE DRY

Want progress with economy on your wet work? MORETRENCH is the proven answer! Ask us for an estimate.

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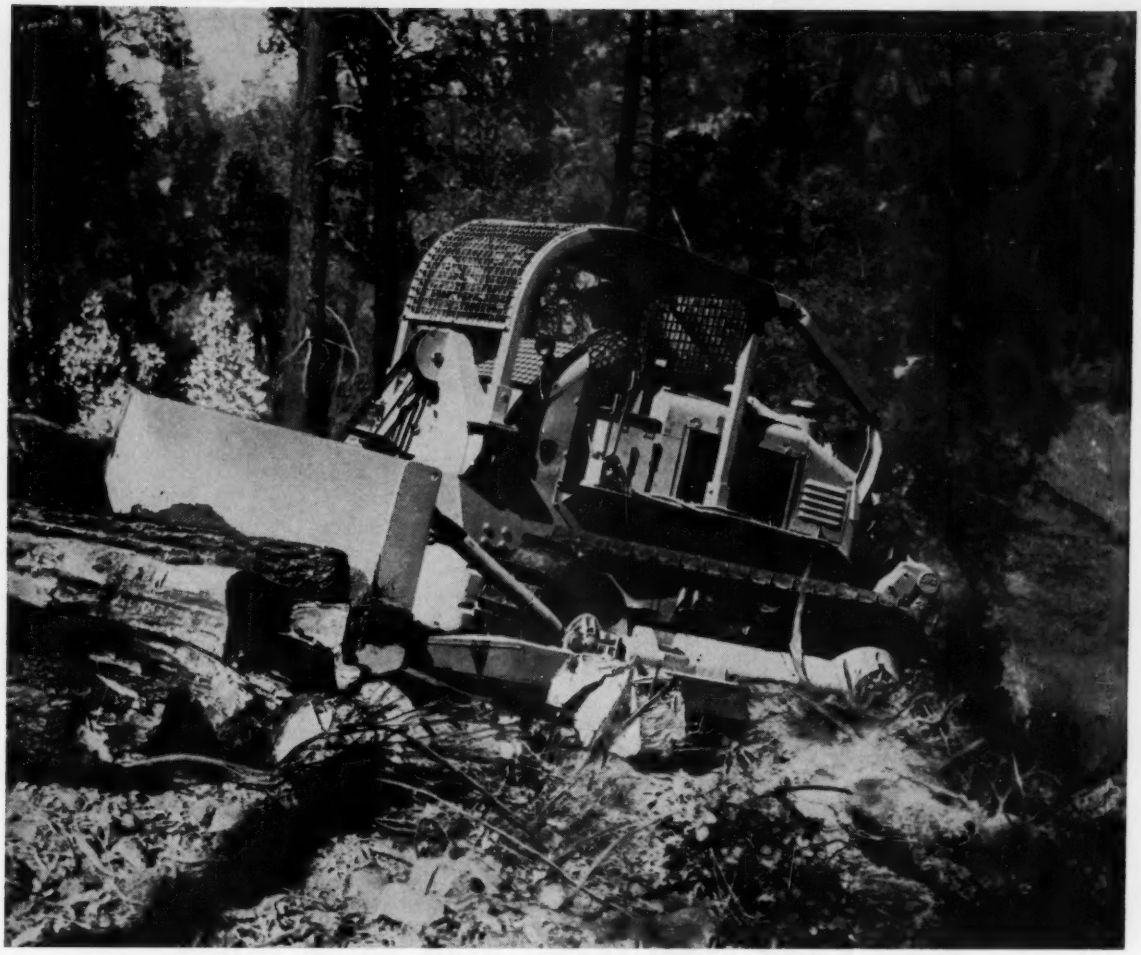


COMPETITIVE TESTS SHOW EIMCO ADVANTAGES

Recent competitive tests have shown again the superiority of Eimco equipment.

Tests conducted in timber and foothill brush were made to determine dozer earth moving and fire line construction ability.

Over a five day period numerous runs were made by impartial crews and judges with experienced operators using an Eimco 105 and a conventional tractor both equipped with bulldozers.

When final results were computed, the Eimco rated "Best" with 33% more dozer earth moving and 11% more fire line construction and the Eimco had also earned operator confidence because it was more stable, easier to operate and would back up 30% steeper grade (the usual method of getting out of trouble).

The features on the Eimco that contributed to its success in the test and outstanding performance under most difficult conditions were: front operator position, better visibility, rear engine mounting, better weight distribution, torque converter, better location and protection of cooling system, better maneuverability (through independent track control) simple controls which eliminate clutch pedals, steering clutch levers, master clutch and manual gear shift lever.

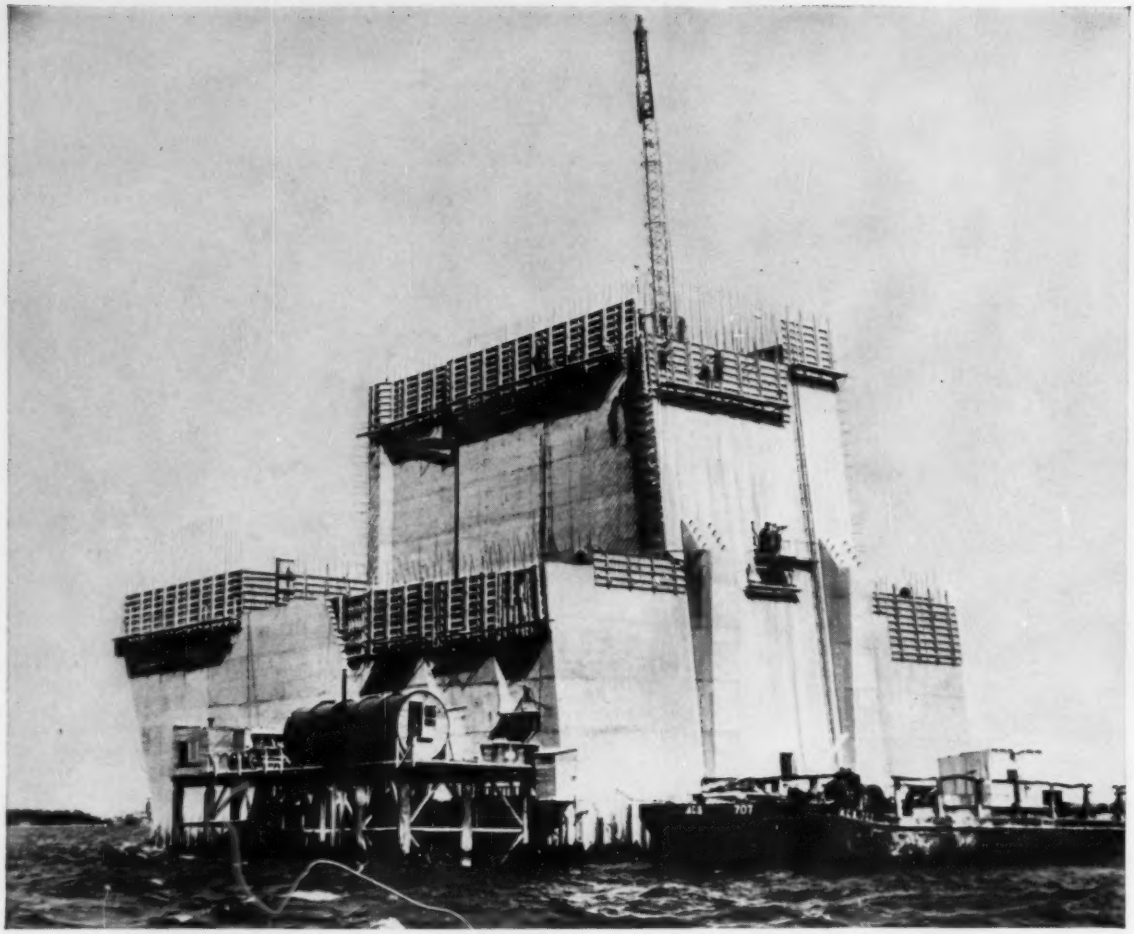
Eimco tractors with bulldozer or excavator attachments are demonstrating their superiority of performance and economy of operation on highways, construction jobs, in mines and in numerous other applications. See the Eimco Tractor before you make any decision on new equipment.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-202



Blaw-Knox steel forms help solve tough concreting problem on world's longest suspension bridge

Merritt-Chapman & Scott Corporation Make Largest Single Concrete Pour in One Day

When it was decided to place the 450,000 cu. yds. of concrete in the substructure for the Mackinac Bridge by the Prepakt method, special steel forms had to be designed to withstand pressures much higher than usually encountered on concrete construction projects.

Blaw-Knox Steel Form engineers were asked to design such forms by Merritt-Chapman & Scott, contractor for the 33 piers of the substructure. The Blaw-Knox engineers developed a series of form sections 10′6″ high, consisting of four panels. After the first pour had set, the forms were moved up so that the bottom panels overlapped the set concrete. This permitted 7′10″ pours from then on.

The combination of Merritt-Chapman & Scott's ingenuity, the specially designed Blaw-Knox Forms, and the method of pouring the concrete, has resulted in record concrete placing . . . 6250 cu. yds. in one 24-hour period . . . 33,068 cu. yds. in 7 days . . . 103,107 cu. yds. in 30 working days.

When you have a concreting problem . . . whether it is a bridge, big dam, tunnel, retaining wall or sewer . . . it will pay you to take advantage of Blaw-Knox forming experience. Blaw-Knox has probably solved similar problems for other contractors who call in the Blaw-Knox Steel Form Consultation Service in the preliminary planning stage, *before* the plans are drawn.

Blaw-Knox Steel Forms Consultation Service is available to any contractor without obligation. Write, wire or phone today.

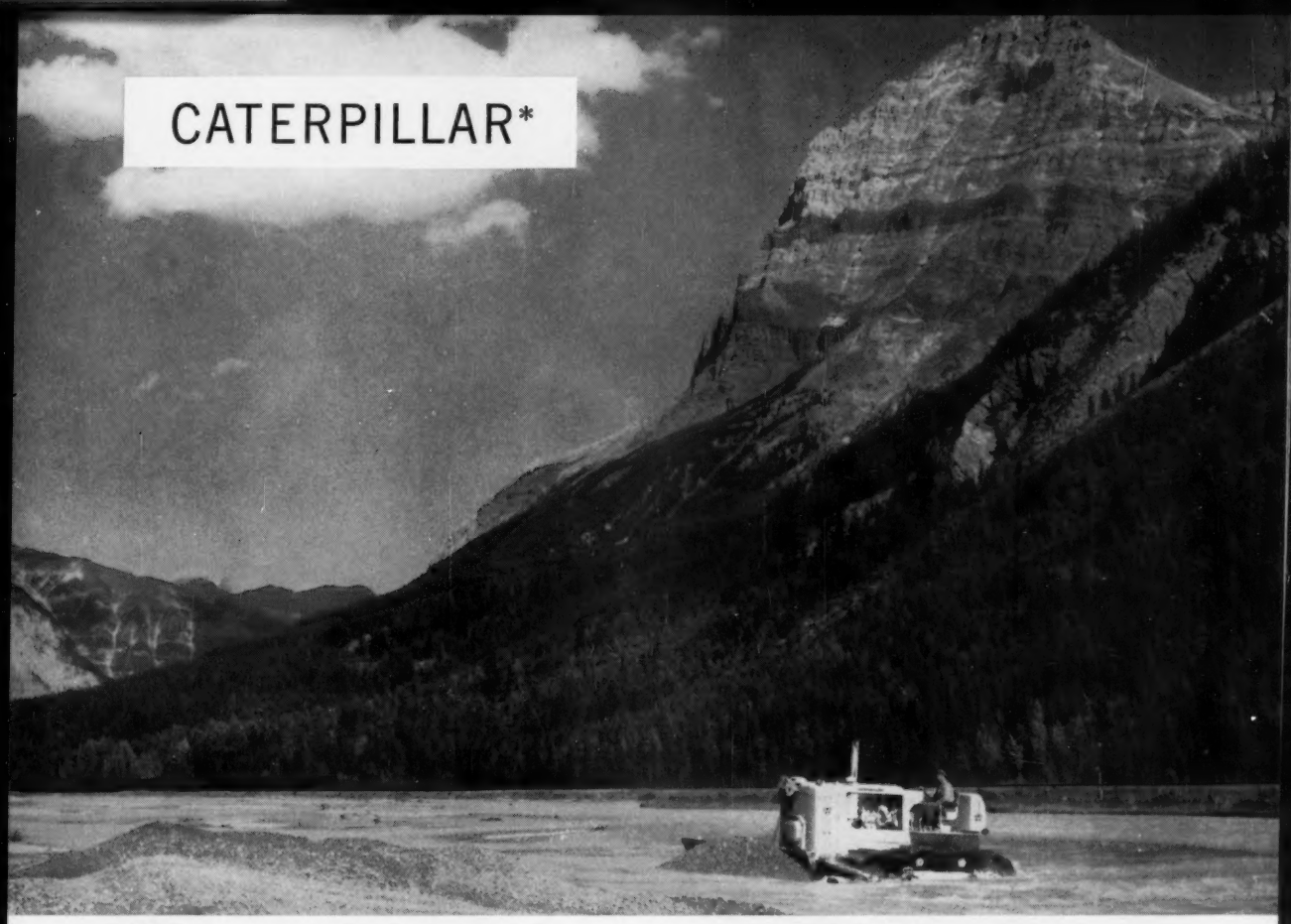
STEEL FORMS CONSULTATION SERVICE

BLAW-KNOX COMPANY

STEEL FORMS DEPARTMENT • BLAW-KNOX EQUIPMENT DIVISION
P.O. BOX 1198 • PITTSBURGH 30, PA. • TELEPHONE STERLING 1-2700

50th Anniversary BLAW-KNOX 1906-1956

CATERPILLAR*



IN BRITISH COLUMBIA, a D9 builds a dike to keep water from a borrow pit where it is push-loading DW21s on the Trans-Canada Highway construction. The owner, General Construction Co., Limited, Vancouver, reports, "This D9 push-loads 225 DW21s and Scrapers per day with river-run gravel." The D9 is equipped with a No. 9A Bulldozer.

IN JUST ONE YEAR, THE D9 WINS COMPLETE ACCEPTANCE

Across the continent, contractors make it standard equipment on tough jobs

Just one year after its introduction, the Caterpillar D9 Tractor—the biggest yellow machine of them all—is standard equipment in the construction industry. From British Columbia to Florida . . . from Massachusetts to California . . . on every conceivable type of job . . . enthusiastic reports roll in from satisfied contractors who have bought it. The exclusive Turbocharged engine of this Caterpillar giant is making the dirt fly on highway construction and relocation, on land clearing projects, dam and canal jobs, and at large building developments. Reports Minnesota contractor George W. Johnson, "Here is packaged power that we, of the construction industry, never have been offered before." Whatever the reason for this universal enthusiasm . . . power, ease of operation, simplicity of maintenance . . . one fact stands out. Never before has a piece of heavy equipment been accepted and put to use so quickly. CONTINUED

NEAR CHARLESTON, S. C., a D9 clears and 'dozes 150 acres in Bushy Park project to develop water sources on a $4½ million industrial site development. Over 3 million yards will be moved by owner, Robert E. Lee & Co. of Manning.

D9 ACCEPTED *(continued)*

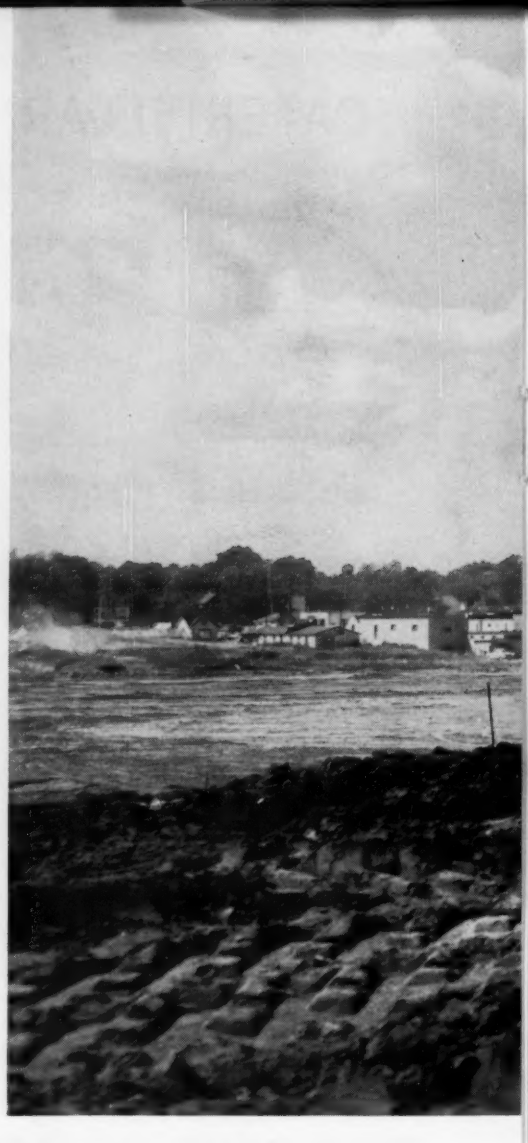
BIGGEST TRACTOR PASSES ITS TEST BY FIRE

The first year in the field is always the most crucial for new equipment. Performance is watched closely and weighed carefully by veteran contractors. Here the D9 passes its first birthday with flying colors on widely different jobs across the nation . . . in soil conditions that include sand, peat, yellow and blue clay, decomposed granite, boulders, shale and gravel.

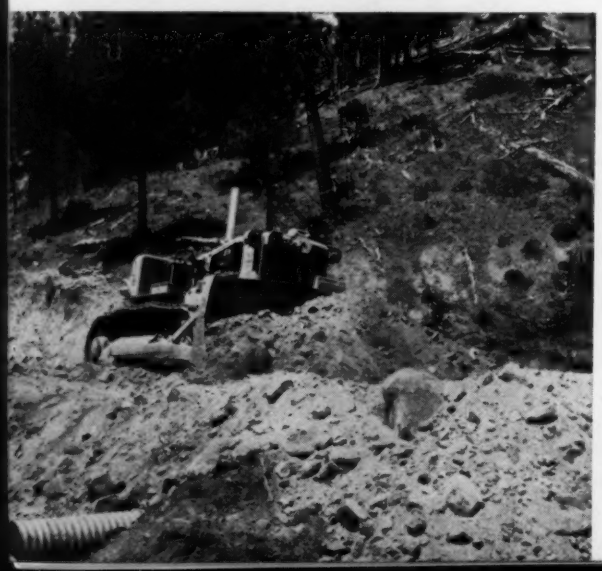
Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

IN MONTANA, a D9 push-loads a No. 90 Scraper on a U.S. Highway 93 project for its owner, Bud King Construction Company, Missoula, Montana. The 31-cu.-yd. (heaped, with sideboards) No. 90, pulled by a D8, is working in a 150,000-cu.-yd. cut near Florence, Montana.



NEAR IDAHO CITY, a D9 pioneers sidecuts, widening and relocating a 11.37-mile section of highway for Morrison-Knudsen Co. In rock and sand, the D9 is making 40 passes an hour, 14 ft. wide, 200 ft. long.



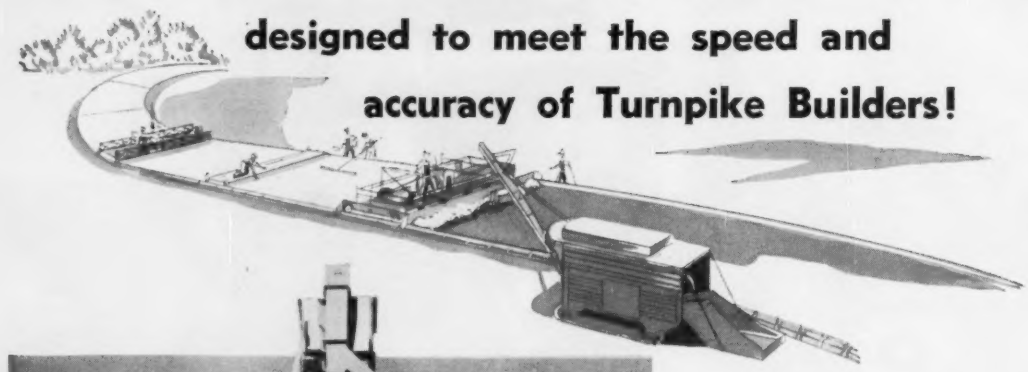
IN STRAWBERRY, CALIF., a D9 builds a 4-mile access road to Beardsley Dam site. The owners, Tri-Dam Constructors of Strawberry, are roughing out this road in 60 days. Soil is decomposed granite and boulders.

IN PARAMUS, N. J., building a shopping center, a D9 'dozes shale and clay to help load scrapers quickly for Sam Braen Construction Co., Wyckoff, N.J. After 'dozing, the D9 push-loads two CAT* DW21s in less than 60 seconds.

IN MINNESOTA, this D9 singlehandedly reduces this cut (450 ft. long by 150 ft. wide) to 8% grade for its owner, Johnson Construction Co., Grove City. The D9 handles 10 to 15 yards a pass on the cut involving 237,000 yd. of fine sand, blue and yellow clay. Job is relocation and widening of U.S. Highway 16.

Strictly for Production

New Heltzel Batchmaster Plants designed to meet the speed and accuracy of Turnpike Builders!

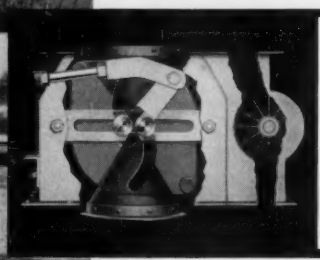


HERE are the paving plants the industry has been looking for! Big capacity Heltzel Batchmaster Production Paving Plants that have the portability, speed and accuracy to more than meet modern day work schedules and job specifications.

Let's look at the Standard E-3 Automatic Cement Batchmaster. Of flare leg design, to permit easier truck access, the plant has the exclusive Heltzel combination gravity vane cement charger (below) that means the fastest, most accurate batching yet possible. Designed for fast, easy dismantling, it easily comes within the dimension limitations for over-the-road hauling. The plant itself will hold up to 609 bbls. of cement. Add Heltzel's high speed recirculatory system and this capacity can be expanded to over 1600 bbls. Smaller size recirculators also available.

A perfect mate to the E-3 is the Type 200 Batchmaster aggregate plant. It is a sturdily built, portable plant that holds a full 200 tons. Yet it can be quickly dismantled into four sections for transporting from one location to another. It is compartmented to suit requirements. It will carry the largest batchers made, including Heltzel's exciting new electronic unit.

If your program for this year calls for the placement of a large quantity of concrete, these plants will save their initial cost in short order. Before you buy equipment, let us show you their many advantages. And remember, it costs no more to own Heltzel Batchmasters—so why not operate with the finest.



The amazing Heltzel Combination Gravity Vane Cement Charger that permits cement batching with a speed never before attained, to an accuracy that has rewritten the record books. It's standard equipment on all automatic Batchmaster plants.

THE HELTZEL

Paving!

HELTZEL

BATCHING PLANTS

9897

Heltzel is one of the nation's leading proponents of automatic and electronic batching. Let their sales engineers show you the latest in these modern day batching techniques.

STEEL FORM AND IRON COMPANY

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NEWS OF ENGINEERS

Charles E. Wuerpel has been elected vice-president of the Marquette Cement Manufacturing Co., Chicago, Ill. Mr. Wuerpel joined the Marquette staff in 1948 as director of the Technical Department, which he will continue to head.

Edmund Astley Prentis, partner in the New York engineering firm of Spencer, White & Prentis, was awarded an honorary degree of doctor of science at Columbia University's 202d commencement exercises held on June 5. Mr. Prentis was hailed as a distinguished engineer and loyal alumnus. He graduated from Columbia fifty years ago this June, and received a mining degree fifteen years ago. Mr. Prentis is a former Director of ASCE.

Leonard S. Hubbard, captain, U. S. Coast and Geodetic Survey, and Seattle District Officer, has retired after 33 years of service. A civil engineering graduate of Tufts College, Captain Hubbard joined the Coast and Geodetic Survey in 1923. He was commanding officer of the Lester Jones, and in 1953 and 1954 commanded the Hydrographer. Captain Hubbard also served as supervisor of the Northeastern District, and in the Washington office as chief of the Hydrography Branch of the Division of Coastal Surveys.

FROM THE FILES OF DR. CENTRILINE...

CASE #6042

PATIENT: 36 miles of twin 20" Cast Iron supply lines, Portsmouth, Virginia.

SYMPTOMS: Insufficient water in Portsmouth.

DIAGNOSIS: Low pipeline capacity caused by flow restricting tuberculation.

TREATMENT: The twin 20" mains were cleaned and cement lined in place without interruption of water supply service to Portsmouth. The Centriline Process of centrifugally applying cement mortar was used.

RESULTS: Each pipeline is now capable of permanently carrying twice as much water as prior to cleaning and lining.

Examine your own capacity, corrosion and leakage problems to determine the value of the Centriline treatment to you. Cleaning and cement lining in place has been the successful remedy for almost 1,000 miles of water supply pipelines.

CENTRILINE CORPORATION

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Branch Offices in Principal Cities of the United States, Canada, and Latin America.

Leon Zach has been elected to honorary membership in the American Institute of Architects. He is chief of the Planning Branch, Engineering Division, Military Construction, in the office of the Chief of Engineers. Since 1941 he has also been principal adviser to the Department of the Army on selection of sites, master planning, and mobilization planning of Army installations throughout the world.

Carl A. Weers has been promoted to the position of assistant chief engineer of the National Board of Fire Underwriters in its San Francisco office. With the National Board since 1937, Mr. Weers has worked in the New York, Chicago and San Francisco offices, dealing chiefly with engineering surveys of the fire protection facilities of the nation's major cities, the National Building Code and the Fire Prevention Ordinance.

C. A. Weers

John N. Eckle, assistant professor of civil engineering at Yale University, retired in June after 35 years on the Yale faculty. Professor Eckle graduated from Yale Sheffield Scientific School in 1910 and received his civil engineering degree there in 1926. He joined the Yale faculty as an instructor in mechanical drawing and descriptive geometry, and was promoted to assistant professor in 1927. For the past three summers he has directed the Yale Engineering Camp at East Lyme, Conn.

Alfred C. Leonard was recently appointed an associate in the firm of Malcolm Pirnie Engineers, consulting engineers of New York City. Mr. Leonard has been with the firm since 1949.

Louis S. Bernstein has become engineering consultant for the System Project Engineering Department of the Niagara Mohawk Power Corp. at Buffalo. Mr. Bernstein joined the company in 1914 and has been chief design engineer since 1935.

Sam M. Hunter, Jr., announces the opening of an office for the practice of structural and soils engineering at 1224 Pickens Street, Columbia, S. C. Mr. Hunter was formerly a structural engineer with the Corps of Engineers.

Lloyd D. Knapp, city engineer of Milwaukee, Wis., and former Director of ASCE, has been appointed Commissioner of Public Works for the city. **Eugene A. Schmidt** will succeed him as city engineer. Mr. Schmidt was formerly assistant construction engineer for the Bureau of Sewers.

John A. Logan, professor of civil engineering at the Northwestern Technological Institute, has been named associate director of the new Transportation Center at Northwestern University. Professor Logan will supervise the center's educational research and other operational activities. The only one of its kind in America, the center will begin operation this fall.

Jean Vincenz, director of public works for San Diego County (California), recently served as a member of the President's Advisory Committee on State and Local Public Works. The group met June 18 and 19 at the White House to "formulate yardsticks to measure the extent of needs in highways, schools, water supply and sanitation. Mr. Vincenz is president of the San Diego Section.

David W. Heiman (center), Colonel, Corps of Engineers, U. S. Army, receives star upon his promotion to Brigadier General, at the Engineer Center, Fort Belvoir, Va. Officiating is Brig. Gen. Gerald E. Galloway, commanding general of the Engineer Center, Fort Belvoir. General Heiman has served as assistant commandant of the Engineer School since October 1955. Shown with them is Mrs. Heiman.

(*Continued on page 24*)

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ABNEY LEVEL

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CONVENIENCE-ENGINEERED FOR FAST, ACCURATE WORK

General Leveling — Measuring Heights
Checking Grades — Topographic Mapping

Compact, dependable instrument made for lifetime service. Supplied with 4 scales held in milled slide ready for immediate use without removing and reversing arc frame. Precision controlled index arm gives accurate readings. Bubble magnifier adjusts internally—no eyepiece to retract for carrying . . . no re-focusing for every job.

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Degree
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Complete with all 4 commonly used scales and saddle leather case. Abney Level Handbook included.

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Illustrates and describes how to make full use of your Abney Level. Furnished with each Abney Level, or send 25c per copy

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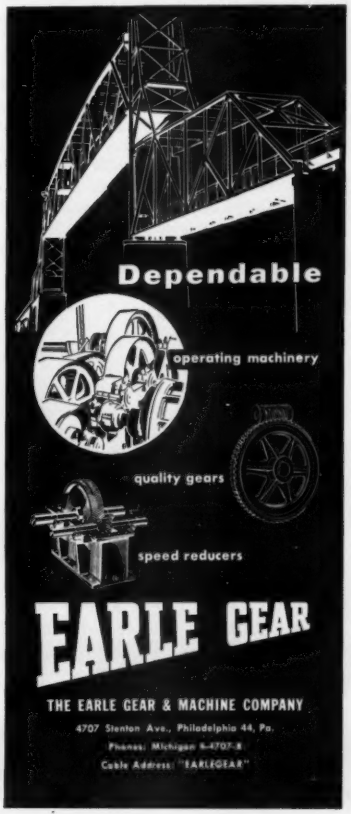


TIDE GATES

Fig. B-124-D

Two 60" Type M Gates on Relief Culverts near Woodward Pumping Station, Plymouth, Pa.

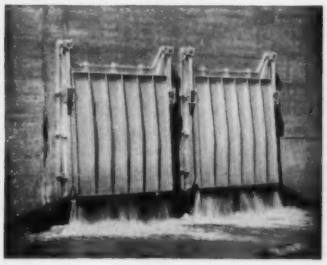


Fig. B-124-C

Two 72" x 72" Type M-M Gates on Toby Creek Outlet Works, Plymouth, Pa.

BROWN & BROWN, INC.
LIMA, OHIO, U. S. A.

News of Engineers

(*Continued from page 23*)

Carlos S. Ospina and **Hernando Quijano** of Bogota, Colombia, have been awarded the National Engineering Prize for 1956 by the Colombia Society of Engineers, for a report on the development of the Guadalupe River for power. Mr. Ospina is a partner in the engineering firm of Olarte, Ospina, Arias & Payan Ltds., of Bogota, and Mr. Quijano, a principal associate.

Robert H. Lyddan was recently appointed assistant director of the U. S. Geological Survey. Mr. Lyddan has been regional engineer for the Atlantic regional office, Topographic Division, Arlington, since July 1955. Prior to that he was chief of the division's Plans and Coordination Branch. Mr. Lyddan is former chairman of the Society's Surveying and Mapping Division.

R. H. Lyddan

Arnold C. Moia has been appointed base sanitary and industrial hygiene engineer at Mountain Home Air Force Base, Idaho, as a second lieutenant after completing a course at the School of Aviation Medicine, Gunter Air Force Base, Alabama. He was formerly employed as civil engineer by the Civil Aeronautics Administration, Jamaica, N.Y.

George M. Foster, chief deputy commissioner of the Michigan State Highway Department, was recently elected secretary-treasurer of the Mississippi Valley Conference of State Highway Officials. The three-day conference of the Mississippi Valley group is held annually in Chicago for discussion of ways in which to improve highways.

Kemp W. Reece has been appointed executive vice-president of Ebasco Services, Inc. Mr. Reece formerly was vice-president in charge of engineering and construction and was in charge of supervision of Ebasco's appraisal, engineering, construction, purchasing and inspection work.

William J. Armento has been appointed adjunct professor in the department of civil engineering at Polytechnic Institute of Brooklyn, effective September 1. Mr. Armento has been teaching courses in concrete design and foundation engineering in the evening session for the past seven years and has also been associated with the firm of Moran, Proctor, Mueser and Rutledge, consulting engineers.

John Brumbaugh has been appointed borough engineer of Oakland, N. J. The principal in John Brumbaugh and Associates, civil engineering firm of Mahwah, N.J., Mr. Brumbaugh has extensive experience in the field of long-range water supply and sewage disposal. His present company specializes in drainage, soils engineering, pavement design, land surveying, sanitation and sewage, industrial, commercial and residential site planning.

Frank H. Gardner, district engineer with the Asphalt Institute, has been transferred from Albany, N.Y., to Atlanta, Ga., assuming his new duties on June 18. Mr. Gardner is returning to a section he knows well, having been with the Alabama State Highway Department, the Florida State Road Department, and the Tennessee Valley Authority.

Garrie B. Haulenbeck has been elected president of the Raritan Valley Society of Professional Engineers for the coming year. He is sales manager of the Construction Service Company in Bound Brook, N.J. He has been with the company since 1942.

Tahlman Krumm has been elected president of the Exact Weight Scale Co. of Columbus, Ohio. Mr. Krumm has served on the firm's board of directors since 1948 and was elected vice-president in 1954. He is also an active partner in Burgess & Niple, consulting civil engineering firm.

Robert Wood Tate has accepted a position as assistant project engineer with the Ralph M. Parsons Company of Los Angeles, after completion of three years with the Air Force Installations Representative (AFIR) Offices. Originally assigned to the Mediterranean Region AFIR in Casablanca, he served as project officer on Air Force construction in French Morocco, Libya and Saudi Arabia.

John M. Bird has been appointed chief of the Department of Soils Section and assistant chief of the Soils and Geology Branch of the South Pacific Division, Corps of Engineers, San Francisco. Mr. Bird was formerly connected with the Snow, Ice and Permafrost Research Establishment, a Corps of Engineers Research and development organization at Wilmette, Ill., where he was chief of the Snow and Ice Applied Research Branch.

Harry Vought, general superintendent of construction with the New York City Housing Authority in charge of testing all materials, has been promoted to the rank of Commander in the U. S. Naval Reserve. Commander Vought has served over twenty-three years in the Naval Reserve.

Harry Vought

Harry J. Bernat has been appointed a division manager of the Kaiser Engineers Division of the Henry J. Kaiser Company, Oakland, Calif. Mr. Bernat joined the Kaiser Organization in 1940 as assistant construction superintendent for marine facilities for the Corps Christi Naval Air Station, and for the past two years has been project manager at Oakland.

Vladimir N. Nichols, for the past ten years vice-president and general superintendent of the George W. Rogers Construction Corp., of New York City, is resigning to assume the position of superintendent of construction operations of the Leo Butler Co., of College Park, Md.

V. N. Nichols

Harvey O. Banks, temporary state engineer of California, has been named director of the new California State Department of Water Resources, with headquarters at Sacramento. **Marcel J. Shelton,** general manager of the La Mesa, Lemon Grove and Spring Valley Irrigation District at La Mesa, has been appointed deputy director. Both appointments will be effective July 5. Mr. Shelton recently served a term as Director of ASCE.

Frederick C. Gardner, president of Ebasco Services, Inc., of New York, was elected to the board of directors of the Commerce and Industry Association of New York, Inc., at its recent annual meeting.

Paul E. Hall, civil engineer of Houston, Tex., was recently elected vice-president of the Wyatt C. Hedrick Engineering Corp., of Houston. He will be in charge of sales and development. Mr. Hall was formerly vice-president of the Texas Northern Corp., of Houston.

Leo H. Corning has been given the new title, director of promotion planning and engineering services at the Portland Cement Association, Chicago, Ill. In his new position he will devote full time to the expanded requirements of technical promotion. Mr. Corning joined the association in 1929, and has been director of promotion since 1952.

Paul S. Jones joins the list of engineer-authors with *Afghanistan Venture.* The 450-page volume (obtainable from the Naylor Company, San Antonio, Tex., for $6) reports Mr. Jones' recent experiences as senior engineer for Morrison-Knudsen on construction of a huge reclamation and irrigation project near Kandahar, Afghanistan. Mr. Jones' home address is 3800 Minnesota Avenue, Fair Oaks, Calif.

A. J. Johannessen and **John G. Girand,** consulting engineers of Phoenix and Tucson, announce the removal of their Tucson office to the Fiber Building, 15 E. Alameda, Tucson, Ariz.

Royce J. Tipton of Tipton and Hill, Inc., consulting engineers, announces the removal of the firm's Los Angeles office to 609 South Grand Avenue, Los Angeles 17, Calif.

Build a National Swimming Pool in Seven Days at One Third Savings!

Pre-Stressed, Pre-cast Concrete Units Solve Labor Costs

The NATIONAL POOL package is delivered to job site in a trailer truck and includes all fittings special interlocking concrete units, vertical pre-stressing bars, marble-lite material for interior finish and filter system which purifies and keeps water safe for healthful swimming. Construction requires no special equipment and can be done with inexperienced local labor. Specially designed pre-cast interlocking concrete wall sections fit into each other and solves cost problem. Pool Walls are scientifically pre-stressed to prevent cracking. New method puts swimming pools within reach of all budgets. *(Valuable dealer-franchises available to qualified builders, write today for full information)*

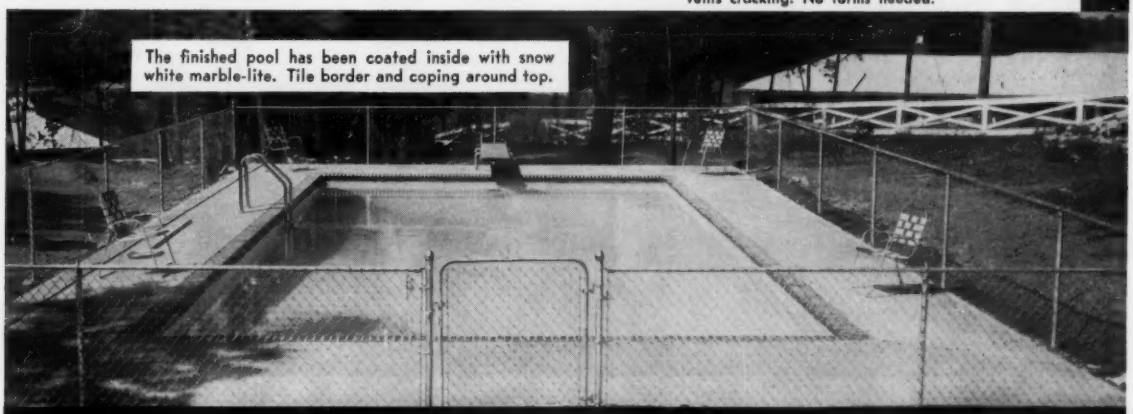
PRICES START AT $1,300.00 for 16′ x 32′ PRIVATE POOL COMPLETE WITH FILTER SYSTEM, PUMP, MOTOR AND FITTINGS. PUBLIC POOL PACKAGE PRICE STARTS AT $3464.00 for 20 x 40 POOL. PUBLIC POOL PACKAGES ARE AVAILABLE FOR OLYMPIC SIZE POOLS.

Refer to the May issue of Coronet magazine on NATIONAL POOLS

Excavation for pool showing steel reinforcement for floor and inside pool walls.

Vertical pre-stressing steel rods are ready for interlocking pre-cut wall sections to be placed over them. No heavy construction equipment needed. All work can be done with inexperienced labor.

Walls being pre-stressed by tightening nuts above steel bearing plates, after concrete mixture has been poured inside pre-cast concrete sections. Prevents cracking. No forms needed.



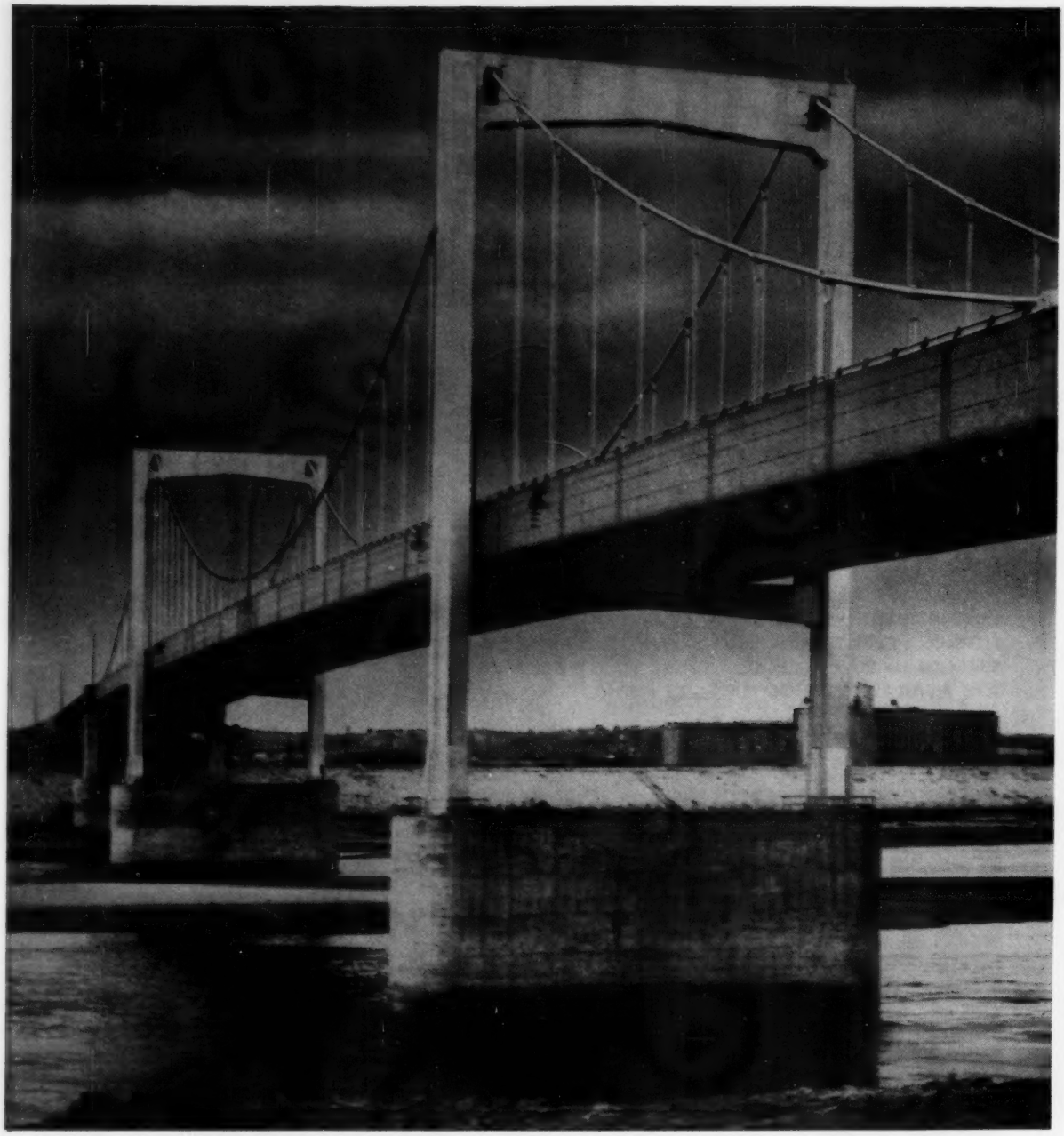
The finished pool has been coated inside with snow white marble-lite. Tile border and coping around top.

NATIONAL

P. O. BOX 888 • BIRMINGHAM, ALABAMA

pool equipment co.

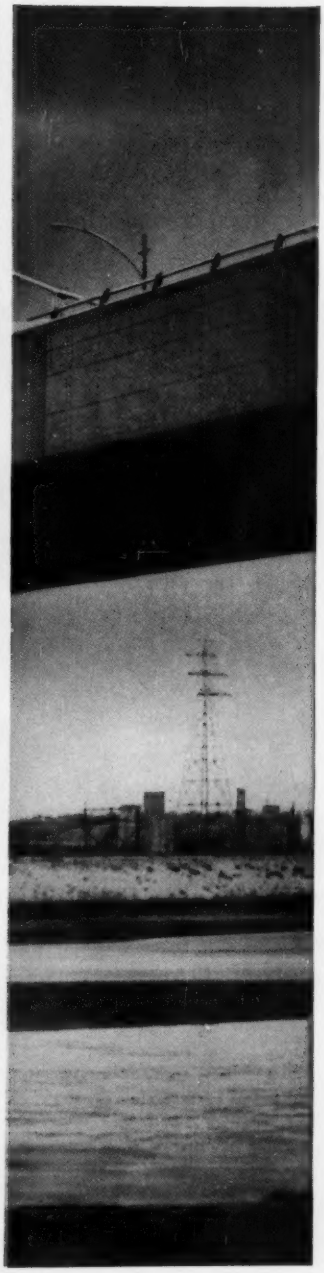
Saved- 300 tons of steel..



USS HIGH STRENGTH STEELS

—the big step forward in bridge construction

• in prize-winning Paseo Bridge built with USS TRI-TEN "E" Steel



Selected by the American Institute of Steel Construction from a field of 90 entries, Paseo Bridge crossing the Missouri River at Kansas City was awarded first prize as the most beautiful steel bridge in the U. S. with a span of over 400 ft. opened for traffic in 1954.

This handsome 4-lane structure is the world's largest existing self-anchored suspension bridge. 1,232 ft. in length, it features a 616 ft. main span and two side spans of 308 ft. each. Supporting towers are 136 ft. high. The suspension unit is flanked by continuous deck girder spans at each end resulting in a total length of 1,825 ft. for the main river bridge.

Aside from its graceful lines and unusual self-anchored construction, the Paseo Bridge deserves attention as another outstanding example of the money-saving reductions in weight that can be effected by the proper use of low alloy, high strength steel . . . in this case, USS TRI-TEN "E" Steel.

A design based on the use of structural silicon steel required 3,450 tons of silicon steel in the towers, stiffening girders and adjacent deck girders. In contrast, an alternate design adopted, using USS TRI-TEN "E" Steel, reduced the tonnage needed to 3,150 tons.

In addition to saving 300 tons in weight, TRI-TEN "E" Steel lent itself readily to welding.

Here are pertinent facts about USS TRI-TEN "E" Steel to bear in mind when you are looking for the best and most economical construction:

USS TRI-TEN "E" Steel is a low alloy, high strength steel that meets all the requirements of ASTM Specification A242. It can be used for riveted bridges but is particularly applicable where welding is a primary consideration. With a yield point 50 % higher than that of structural carbon steel (ASTM A7) in thicknesses of ¾" and less, it combines atmospheric corrosion resistance equal to that of copper bearing steel. That is why TRI-TEN "E" Steel can safely be used in lighter sections to reduce weight and save steel. The smaller tonnage of steel thus required not only results in savings in material costs, but in reduced cost of steel transportation and in the size and cost of foundations. Together these savings add up to cost reductions that in some cases have run as high as 15% of the cost of the structure.

Our engineers will be glad to show you how USS TRI-TEN "E" and our other USS High Strength Steels—USS COR-TEN and USS MAN-TEN—can be incorporated into your designs to provide maximum strength, safety and durability with a minimum of weight and costs.

The Paseo Bridge at Kansas City, Missouri

Owners—JACKSON COUNTY AND CLAY COUNTY, MISSOURI
Consulting Engineers—HOWARD, NEEDLES, TAMMEN AND BERGENDOFF
Fabricator and Erector—AMERICAN BRIDGE DIVISION, UNITED STATES STEEL

USS

UNITED STATES STEEL CORPORATION, PITTSBURGH • AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

UNITED STATES STEEL

'Faster From Foster' meant plenty on this extra-tough pile driving job

This contractor was driving piles through silty material made soft by a heavy, rainy season. And he had to work in a narrow, twisting, busy street. No space for job-site storage, and as always, a heavy cost penalty for time lost waiting for late materials. By renting 27 to 33-ft. lengths of steel-sheet piling from L. B. Foster Company, he got deliveries *as the piling was needed*—delivered by Foster trucks over routes planned during light traffic periods. All the headaches that could have been the contractor's were eliminated by using the Foster Piling Rental Plan, and the pile driving was completed on schedule.

Foster Piling Rental Service is complete—for all types of steel-sheet piling (and lightweight piling). You get the right type, the exact section, the exact length . . . when you need it . . . and on the low fixed cost of our rental plan. Ask your nearest Foster office for details and prices on your temporary piling needs, and see for yourself the savings in the Foster Piling Rental Plan.

"FASTER FROM FOSTER"

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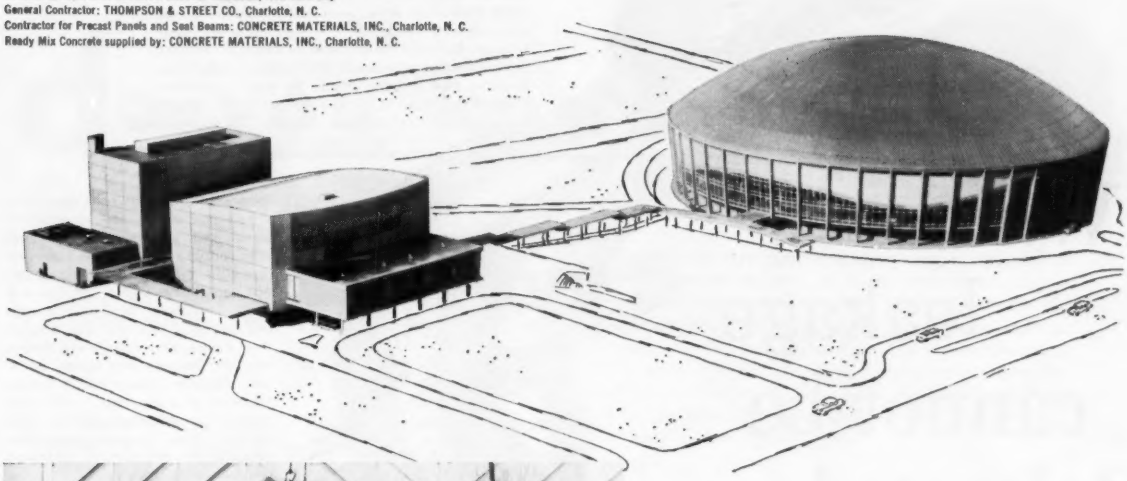
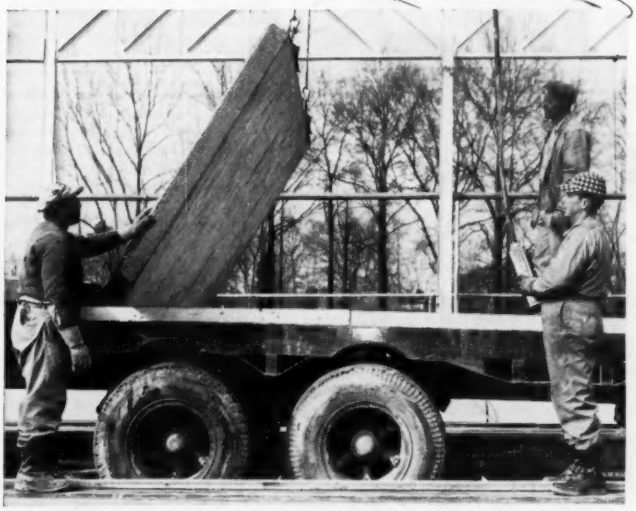
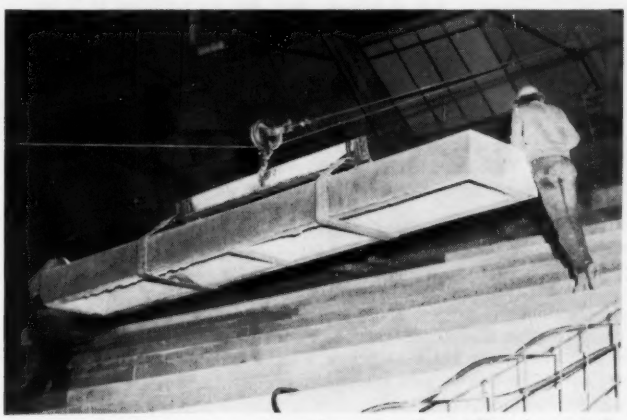
L. B. FOSTER CO. PITTSBURGH 30, NEW YORK 7, CHICAGO 4, HOUSTON 2, ATLANTA 8, LOS ANGELES 5

Architect: A. G. ODELL & ASSOCIATES, Charlotte, N. C.
Consulting Engineers: SEVERUD-ELSTAD-KRUEGER, New York City
General Contractor: THOMPSON & STREET CO., Charlotte, N. C.
Contractor for Precast Panels and Seat Beams: CONCRETE MATERIALS, INC., Charlotte, N. C.
Ready Mix Concrete supplied by: CONCRETE MATERIALS, INC., Charlotte, N. C.





One of 600 precast concrete wall panels made with Lehigh Early Strength Cement. Averaging 7½′ x 20′ in size, the panels form 60,000 square feet of the exterior walls in these structures.



Placing one of 1000 precast concrete seat beams in coliseum. These beams, each weighing 4000 lbs. were also made with Lehigh Early Strength Cement. Seating capacity of coliseum is 10,000.

trend toward **tomorrow...**

The David Ovens Auditorium and the Charlotte Coliseum, Charlotte, N. C. illustrate the trend toward concrete for tomorrow's construction. By combining precast and cast-in-place concrete the designers and contractors have provided structures that are durable, functional and pleasing to the eye.

Lehigh Cements were used throughout. In the manufacture of the 600 precast exterior wall panels and 1000 precast seat beams, Lehigh Early Strength Cement was used to cut labor, curing and overhead costs by 50%. Dependable Lehigh Portland Cement was used in the ready mix concrete for all cast-in-place concrete. Lehigh Mortar Cement was used to lay up all masonry units.

Whether you build big or small, traditional or modern, there are Lehigh Cements to meet your requirements. And remember, somewhere on nearly every job, Lehigh Early Strength Cement will save you time and money.

- LEHIGH EARLY STRENGTH CEMENT
- LEHIGH PORTLAND CEMENT
- LEHIGH AIR-ENTRAINING CEMENT
- LEHIGH MORTAR CEMENT

LEHIGH PORTLAND CEMENT COMPANY

ALLENTOWN, PA.

Soils of resistivities under about 2,000 ohm-cm, or soils of widely varying resistivities averaging even 5,000 ohm-cm or more, are usually quite corrosive. For such soils Somastic® Pipe Coating is the ideal solution. To avoid the expense of frequent changes in pipe treating equipment and crews on long lines, Somastic Pipe Coating should be used in sections of perhaps five to ten miles minimum length through such soils, even though intermediate stretches were of higher resistivity.

Where leakage cannot be tolerated...

Wherever pipe lines traverse city streets and subdivisions or valuable agricultural property, or lands that may soon be converted to such use, Somastic Pipe Coating is recommended. This added precaution is a good investment against the cost and public ill will that would result from a leak, even though soil studies may not indicate that severe corrosion should be anticipated. A further factor in such locations is that supplementary cathodic protection may not be feasible on poor coating because of the difficulty of obtaining suitable anode locations.

Somastic Pipe Coating has long been the standard for swamp construction, river and harbor crossings, and coated submarine lines. Experience indicates that submarine lines and river crossings can be installed when Somastic Pipe Coating is used without the expensive handling precautions normally required for other coatings. Examples of such use can be supplied including submarine lines in the Persian Gulf, in Lake Maracaibo and in the Pacific.

Although Somastic Pipe Coating can be damaged by unusually rough handling, it is true that it can be installed with a minimum of damage under conditions of mountainous terrain where prewrapped coatings would be damaged in handling and where over-the-trench machines cannot satisfactorily negotiate. Somastic Pipe Coating is usually the best choice when such construction problems are encountered.

Pipe lines are occasionally run through watersheds or river valleys where it is essential that every precaution be taken to prevent leaks. Such locations are an excellent application of Somastic Pipe Coating both because of the protection the coating affords and the evidence given to public authorities and others that the best possible pipe protection is being used.

you'll save money with SOMASTIC® coated pipe lines

SOMASTIC PIPE COATING is available in a number of formulations. Each is an asphalt-mastic designed for continuous, uniform, seamless, impermeable protection.

SOMASTIC PIPE COATING is *thick*. There are fewer pits under thick coatings. It is *seamless*. There are no holidays because of overlapping layers or bubbles. It is *reinforced*. The reinforcement is permanent and uniform. It is *rigid yet elastic* . . . withstands depression over long periods, absorbs pipe movement and changes in pipe line temperature. *Proved* under adverse soil conditions for more than 24 years. *That's why Somastic Pipe Coating will save you money wherever leakage cannot be tolerated!*

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do you know that

If you didn't get to Knoxville you missed a good Convention? Both technical program and entertainment were tops at this A No. 1 Summer Convention, reported in the "Society News" lead story.

Formation of a Pipeline Division has been authorized? This important action of the Board at Knoxville gives Division status to the Construction Division's popular Committee on Pipelines and ups to fourteen the number of ASCE Technical Divisions. Details and personnel will be announced later.

Next year's President has been nominated? Mason Lockwood, prominent Houston consultant and a recent Vice-President of ASCE, received the Presidential nomination for 1957 at the Board's Knoxville meeting. There is a brief write-up about him in the "Society News" section. A more detailed biography will appear later.

A tight construction schedule is being maintained on mighty Bhakra Dam? One of the toughest construction jobs in the world is how contractors describe this 700-ft-high concrete arch dam in Punjab, India. In the August issue M. H. Slocum, director of construction and plant design, and B. R. Palta, superintending engineer-plant design, will tell how American equipment, methods, and techniques aid in pushing work on the mammoth project.

A 33-billion-dollar, thirteen-year road-building program is assured? Legislation for the national highway construction program has passed all Congressional hurdles. Of the huge total planned, some $28 billion is the estimated cost of building the 41,000-mile interstate net of superhighways connecting state capitals—90 percent to be paid by the government. Funds will be allocated on the basis of relative population, size, and mileage of rural postal routes in each state. Compensation to states for interstate roads already built but without federal aid is not provided for.

Niagara rockslide damage is estimated at $100 million? The series of heavy rock falls in the gorge below Niagara Falls, on June 7, wrecked the upstream two-thirds of the 360,000-kw Schoellkopf hydroelectric plant of the Niagara-Mohawk Power Corporation (described in an article in the April 1952 issue, pages 33–35). This disaster adds urgency to the need for action by Congress on the development of the U. S. share of Niagara power.

Spending for new plant and equipment is expected to rise in the third quarter? A recent government survey, quoted by Secretary of Commerce Weeks, shows that the rate of business spending for new plant and equipment is scheduled to rise by an annual rate of $2 billion, assuring a record year for investment spending and confirming earlier predictions. Employment for May hit 65,000,000—a record for the month and close to the all-time record high of 65,500,000 set last August.

The Columbia River has another great dam? After six years of construction, Chief Joseph Dam was dedicated on June 12. With a total generating capacity of 1,743,000 kw, the multiple-purpose project will be second only in power to the 1,974,000-kw plant at Grand Coulee Dam 50 miles upstream. Cost of this huge Corps of Engineers project is some $190,000,000.

Electronic computers are helping to man the highway program? The expanding road program necessitates finding new ways of releasing highway engineers from minor, routine tasks. Electronic computers already have made it possible to produce mass diagrams of earth quantities rapidly and automatically without detailed cross section sheets.

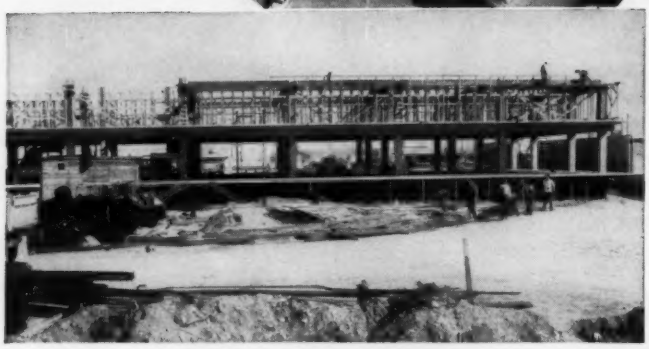
Evaporation is lowering the level of Lake Mead by more than 7 ft a year? This is the finding of the third and last of a series of water-loss investigations under way since 1950 under the auspices of the Geological Survey, the Bureau of Reclamation, and the U. S. Weather Bureau. With evaporation of 796,000 and 699,000 acre-ft during 1954 and 1955, more water is lost this way each year than most reservoirs hold when full. Pending publication, copies of "Water-Loss Investigations" may be seen in Geological Survey offices in leading cities.

The World Bank has made its biggest loan to a single project? This loan of $80 million goes for a start on the big Kariba Gorge Dam on the Zambezi River 300 miles below Victoria Falls in Southern Rhodesia. The loan will cover about a third of the first-stage cost of an arch dam 400 ft high and 1,800 ft long. Underground power stations on each side of the gorge will each contain six 100,000-kw units. Power by 1960 is contemplated.

A new Secretary of the Interior has been nominated? White House Assistant Frederick A. Seaton has succeeded Douglas McKay in the important post of Secretary of the Interior.

Distinction in **DALLAS**

Meadows Building, One of Southwest's Largest, Balances Contemporary Design with Utmost Structural Substance



MEADOWS BUILDING

Owner:
EMPLOYEES' RETIREMENT FUND of GENERAL AMERICAN OIL COMPANY

Operated by:
MEADOWS BUILDING CORPORATION

Architect-Engineer:
J. N. MacCAMMON

General Contractor:
COWDIN BROS.

Ready-mix 'Incor' Concrete:
DALLAS CONCRETE COMPANY

—all of Dallas, Texas

'INCOR' CUTS FORM REQUIREMENTS IN HALF

● First major office structure to be erected outside of downtown Dallas is the $4 million Meadows Building, on Central Expressway in the City's northern suburb. One of the most attractive as well as largest of its type in the Southwest, this handsome new building, with 283,000 sq. ft. of floor space, is really three separate buildings, attractively oriented around one of the country's largest elevated patio gardens, beneath which is a spacious garage.

Matching form with substance, the structures themselves are monolithic concrete, for utmost fire-safety and durability. Care in planning is reflected in the use of 'Incor'* 24-Hour Cement in the concrete frame, with the result that one set of metal forms produced the same job speed as two sets without 'Incor'. Besides form economies, 'Incor' reduces time and overhead costs through earlier completion.

Another chapter in the 'Incor' economy record . . . savings of 30 to 55 percent on form and time costs on structures of all types. Sound reason for scheduling any project so as to take full advantage of the always-dependable performance of America's FIRST high early strength portland cement. *Reg. U.S. Pat. Off.

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CIVIL ENGINEERING

The Presidential Address, of which this is an abstract, was delivered by President Needles before the Membership Luncheon at the Knoxville Convention on June 7, 1956.

OUR EXCITING PROFESSION

ENOCH R. NEEDLES, President ASCE

Partner, Howard, Needles, Tammen & Bergendoff, New York, N.Y.

The profession of civil engineering is as old as the crudest shelter built unknown centuries in the past to protect our forbears against their foes and the elements. This profession is as new as atomic fission itself, if only because of the new materials, methods, problems and power sources which will come necessarily with the Atomic Age. For the civil engineer is a builder, a constructive builder, the provider of structures and facilities for the better living of his fellow man.

We civil engineers are members of a great and honorable profession, an exciting profession, a living profession and a profession of great and continual change. Our American Society of Civil Engineers is now 104 years old, a venerable age by any standard of measurement for professional organizations.

The advance in civil engineering throughout these one hundred years has increased steadily in tempo as the years have gone by. Certainly the advances of the past thirty years will exceed those of the previous seventy years. The advances of the past ten years probably equal those of the twenty years immediately preceding. The coming of the motorized vehicle on land, sea and air, has motorized our entire economy.

As we contemplate the changing tools and equipment of the civil engineer, we can wisely recognize the improving use of our talents as professional men, particularly in the larger organizations. A definite and planned movement is under way to utilize experienced professional personnel more extensively on professional work and in supervisory and administrative positions. Non-professionals or engineer aides are being trained and used far more extensively than formerly for routine work.

A shortage of engineers

Current discussion regarding the so-called shortage of engineers appears to pertain to industrial operations engaging the attention of mechanical, electrical and chemical engineers to a considerably greater extent than does the field of public works and other areas in which civil engineers predominate. Steadily rising salaries in all branches of engineering, including civil engineering, make it clear that there is no current oversupply of engineers. A few statistics pertaining to civil engineering will throw light on this question.

If we agree that the total civil engineer population of our country approximates 100,000, this figure can be compared with a total population of about 165,000,000 and a current Society membership of about 39,000. Of the 61,000 civil engineers who are not members of our Society, a substantial part may be civil engineer graduates who have gone into industry and business, for which they are unusually well prepared. Another substantial part, even though classed as civil engineers for statistical purposes, may not be of Society membership caliber. Also for comparative purposes it has been reported that in 1954 there were 3,955 civil engineering graduates against a total of 292,880 college graduates of all types.

Now if we consider, as of 1955, the average small city of 16,500 population, we get the following simple determinations:

This city is receiving 29 new college graduates each year but only one civil engineer graduate every $2^1/_2$ years. Ten civil engineers in all types of activity reside in this city, and four of them are members of the American Society of Civil Engineers. Of these four, one is a full Member, one is an Associate Member, and two are Junior Members. But only one Junior Member will advance to a higher grade of membership in the Society.

Other statistics indicate that this average city of 16,500 will have 22 doctors of medicine, assuming one physician for each 730 of the population. And there will be 33 attorneys practicing there.

Those of us who have considered the professional civil

engineer to be a rare and distinctive person have plenty of statistics to support our view.

When we speak of a shortage of professional civil engineers, we must not confuse this subject with a temporary short supply of engineer-aides or non-professionals. It is surprising how quickly the supply of such aides can be expanded if the demand exists. The training is intensive and adequate, and the compensation attractive. Witness the war construction activities of 1940–1942. The conditions which appear to exist now should generally result in a transfer of professional men from non-professional fields into more professional positions. When this transfer is completed, when greater use has been made of the growing number of optical, mechanical and electronic devices for professional aid, and when we are unable to further build up the reservoir of non-professionals, we civils can then discuss more realistically this subject of a shortage of engineers.

Of course the supply of professional civil engineers cannot be turned on and off like water at a spigot. Attractive compensation is still the greatest magnet in drawing men to any field of endeavor, professional or non-professional. Intelligence and desire to serve are equally essential factors in professional activity, but the adequacy of compensation will very often determine the field to which the prospective student decides to direct his talents. There is every reason to believe that the currently increasing compensations for engineers will catch the attention of parents and students alike and that our college ranks will soon be filled to capacity—if indeed they have not already begun to approach that state. In due course, perhaps sooner than we expect, the number of engineering practitioners will have increased, possibly to the limit our nation can reasonably be expected to produce.

Inter-society relations

Within a relatively few years after the formation of the American Society of Civil Engineers in 1852, several developments in the form of inventions and highly specialized engineering procedures occurred which resulted in the formation of new technical societies to provide better service to these new, highly specialized fields. The growth and strength of these societies as of today is a measure of the adequacy of the service they have rendered to their members.

During the past 35 years, there has been a growing demand for an agency through which these societies can attack their common problems in an effective cooperative way. An excellent example of such cooperative endeavor is the Engineers' Council for Professional Development. The work ECPD has done in the field of accreditation of engineering curricula during the past twenty years has been monumental, of very far reaching significance, and has established for ECPD an enduring place.

During the past ten years the Engineers Joint Council has been undergoing development. Its strength has become steadily greater, and its position is clearly one of permanence because of the widespread representation of engineering societies in its meetings and councils. EJC provides a common meeting ground where each member society can present its views and take its appropriate position in matters calling for joint activity in behalf of the entire profession of engineering. Representation of each individual professional engineer in EJC through his own technical society is now almost universal or approaching it. EJC is sensitive to the stands taken and views held by its constituent societies. It is an excellent standby forum available for quick action in the event that subjects arise demanding urgent attention.

It may be observed that in years past many comparisons have been drawn between the medical and engineering professions. Undoubtedly the economic status assumed for the individual in each profession had quite a bit to do with these comparisons. There was also discussion of relative professional status. In the minds of most engineers, such comparisons are no longer considered reasonable or appropriate, and we can be satisfied that this is so. Peas have never been compared with peanuts with any degree of effectiveness.

The banding together of our many engineering societies under EJC and ECPD gives full recognition to the many different types of specialized practice in which professional engineers engage and to the great variety of special conditions which surround the many different types of practice. EJC and ECPD cannot hope to fill all the needs of these many different types of engineers, but they can and do function handsomely on broad general problems of vital import to the entire engineering profession.

Our Society and our profession

Our great American Society of Civil Engineers has advanced steadily through the years in vital service to its members and to the profession. It has enabled its members to advance technically and professionally. It has remained a democratic and responsive society. It has afforded fellowship and mutual respect within its membership. In furthering the technical advancement of our profession and its members, the spoken and written word has been used with utmost freedom in our Local Section meetings, in our technical conferences, and in our technical publications. Whatever our employment or nature of service or compensation, whatever our political or social views, technical truths and technical advances provide common ties which bind all of us together and are not to be severed. Our Society must have untold years of increasingly fruitful service ahead.

Last year I had particular reason to review again the qualities and characteristics of a profession and its members. I could find no brief definition of a profession. But all definitions covered four basic truths:

In the practice of a profession proper education and training are most significant. Unusual and thorough preparation for practice is almost paramount.

Next is stressed the importance of ethics in the practice of a profession. We must have integrity. We must be honest with ourselves and with our fellow men. It is unthinkable that a true professional man would be found lacking in basic integrity.

Then there is the element of service—service in behalf of our fellow men rather than services primarily in our own behalf. Service must be a cardinal element in true professional practice.

Finally there is the element of avowal. By avowal is meant the expression of a conscious determination to serve as a professional man—a form of consecration. Without a positive decision or dedication on the part of the individual, service as a professional man would not exist.

These four elements of professional practice, by definition and without argument, are clearly attributes of the individual. If we as civil engineers exhibit these qualities in our individual activities, we are professional men, we know it, and no one can take that knowledge from us. To that degree, our professional status is for us to determine. If we have those qualities, our fellow men will know it and they will respect us and our profession and our Society without reservation. Our status starts with the individual. There can be no profession made up of non-professionals. Laws or rules or claims or shouts will not obtain for us as a group what we are unwilling to attain as individuals—a true professional status.

We civil engineers can be very proud of our Society. Our profession holds many treasures for us. We can know that as we serve our fellow men with our constructive undertakings and our facilities for finer and more complete living and as we build well, we are also serving our God.

HERBERT D. VOGEL, M. ASCE

Brigadier General, U.S.A. (Ret.), Chairman of the Board
Tennessee Valley Authority, Knoxville, Tenn.

Role of the civil engineer in multipurpose river development

For a number of reasons engineers at first were skeptical of the success of multipurpose planning for river control projects. The first reason was undoubtedly their unfamiliarity with the problem and the obvious conflict of ideas in using the same space in reservoirs for both flood control and power. Then, too, projects built for several purposes, with perhaps power storage in the lower part of the reservoir and flood control storage above, required monumental structures which necessitated venturing into new realms of financing and new realms of engineering technique.

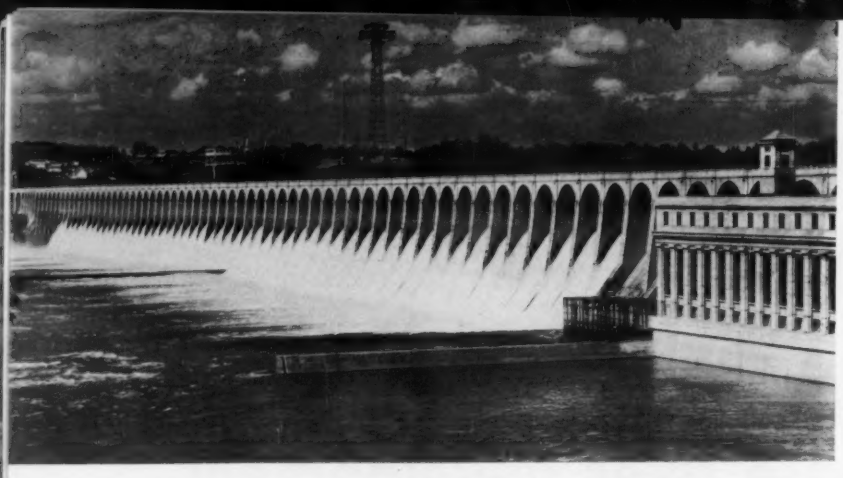
It is an outworn saying that an engineer accomplishes for one dollar what anyone else can do for two, but it still expresses the basic thought that an engineer must be primarily concerned with costs. He develops, improves, and creates, but his eye must always be on the cost of his project in order to get the most done with the least money. Much of his success in that direction is dependent upon the amount of money he has to work with, for quite frequently large expenditures yield the greatest economies. We have found in TVA, for example, that by building steam plants ever bigger, and with bigger units, we are able to generate power at a lower cost per kilowatt-hour than by using smaller plants and units.

Before 1932 the budget for river and harbor improvement was scaled to low levels in consonance with other federal expenditures. Hence it was necessary for engineers to limit their efforts to the most important projects and to prosecute them with relative austerity. Low, single-purpose dams were built in many instances as a means of meeting the needs of navigation at the lowest possible cost. Levees and flood walls were sometimes built to contain the high flows, and upstream reservoirs came as a later adaptation to bring about the integrated development of certain river systems.

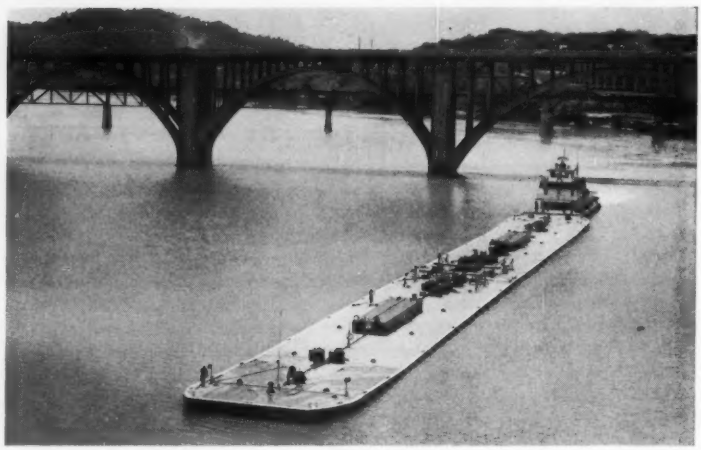
For example, the low dams on the Ohio River were built between 1879 and 1916. The high dams at Dashields and Emsworth were built between 1919 and 1929. Plans are now afoot for replacing all the low dams with high-lift structures. Meanwhile, local protective works were constructed to the degree justified by ratios of benefits to costs, in order that floods might be reasonably restrained. Tygart Dam on the Monongahela River in Pennsylvania created the first upstream reservoir of the system to aid in a further attack on the flood control problem, and this was followed in rapid succession, during the late 1930's and early 1940's, with Crooked Creek, Tionesta, Mahoning, Loyalhanna, and Connemaugh Dams on tributaries of the Allegheny River, and Youghiogheny Dam on a tributary of the Monongahela. These all contributed to the protection of Pittsburgh from floods and, with Berlin and Mosquito Creek Dams, assisted in reducing floods downstream on the Ohio River. Berlin and Mosquito Creek Dams, built in the early 1940's, were truly multipurpose structures in that they provided also for industrial and domestic water supply.

The lesser works of the 1920's resulted, broadly speaking, from the fact that the public realized then in only a limited degree the immensity of the potentialities of our streams. The power of a river as a destroyer of life and property, or on the other hand as a producer of economical power, cheap transportation, and abundant water supply, was not fully recognized. Im-

Eight outdoor-type generators feature TVA's Wheeler Dam (1933–1936) on Tennessee River, about 16 miles above Wilson Dam. Wheeler Dam is 72 ft high and 6,342 ft long.



Wilson Dam's powerhouse has greatest installed capacity of any TVA dam—436,000 kw. Started during First World War, this dam was completed in 1925, and taken over from War Department by TVA in 1933.



Deep-water, all year channel for navigation now is available throughout the 627-mile length of Tennessee River. Heavily laden barges now bring their cargoes to Knoxville, head of navigation.

portant changes in public attitudes took place in the late 1920's and early 1930's which were reflected in broader directives from Congress, more adequately financed. In the field of engineering, they required our builders to exercise much ingenuity in solving problems of structural bigness.

Between 1930 and 1940, heavy construction equipment became more common, and a great deal was learned about the materials used in construction. The science of soil mechanics, unheard of in the early 1920's, made great progress in the 1930's, and in the next decade advanced still further. Mass concrete construction was largely conducted by guess and rule-of-thumb in the 1920's, but in the 1930's we were learning about water-cement ratios, and in the 1940's were being guided by temperature control, compatibility of aggregates, and the use of admixtures. All this led toward the bolder design of larger structures which could serve a greater number of purposes.

Before we jump to the conclusion, however, that our predecessors did not think in terms of maximum site use, we should recall that Madden Dam in the Canal Zone, first proposed in 1927, was built for flood control, navigation, storage, power, and water supply. Not only was this a several-purpose project, but taken together with Gatun Dam, it provided multipurpose development of the Chagres River to make the Panama Canal possible.

Multipurpose development—the TVA

Like humans, rivers take on widely differing characteristics depending on their environment. Those that originate in mountain heights and find their way through narrow valleys to join larger streams, or to find the sea, are more susceptible to control by dams alone than those which meander through wide alluvial valleys. Slope, sediment load, rock outcrops, variations of rainfall within the drainage basin, and a variety of other factors determine the regimen and influence the choice of methods for control and utilization. Levees, floodways, diversions, reservoirs, rectification, canalization, dredging, and bank revetment are all techniques of river control and can be used in various combinations. Each has been employed to some degree on the Mississippi River, considering it as an integral whole from its source to its delta.

The Tennessee River, on the other hand, has succumbed in general to treatment by reservoirs alone. These have been created by a series of nine high multipurpose dams on the main stem and by 15 high storage dams on the upper tributaries.

The story of this development begins with an assignment given by Congress to the Corps of Engineers in 1927. The river surveys which resulted became known as the "308 Reports" and the report pertaining to the Tennessee River basin, filed in 1930, was one of the most exhaustive of its kind up to that time.

The 308 Report on the Tennessee examined and discussed the merits of two broad types of river development. The first was a system of high dams on the main stream augmented by high storage dams on the tributaries. Such a system, the report held, would provide the maximum of flood control, navigation development, and power generation. Potential dam sites for this type of development were located, the type of structures was foreseen, and estimates of cost were made. The Board of Engineers for Rivers and Harbors commented at one point in the report:

"It is evident that the full utilization of the resources of this river for the public benefit requires its improvement by means of high dams built for the joint development of power and navigation."

The alternative was to develop the river for navigation only by the construction of 32 dams with locks of relatively low lift, creating a 9-ft channel from Knoxville to the Ohio. This latter plan was recommended to Congress by the Corps on the theory that the larger three-purpose development would re-

quire the cooperation of power companies which could not be obtained in any reasonable time.

TVA was thus faced, at the time of its creation in 1933, by a major decision as to the type of plan it should adopt. Congress had directed that it proceed to develop the natural resources of the valley to the fullest, and in particular that it improve the navigability and provide for flood control of the Tennessee River. It was also to provide for reforestation and the proper use of marginal lands in the Tennessee Valley; for agricultural and industrial development of the valley; and for the national defense by the creation of a corporation for the operation of Government properties at and near Muscle Shoals. And unlike the Corps, it had a mandate from Congress to develop and market hydroelectric power.

Offhand it might appear that this directive allowed no choice except to build a series of high multipurpose dams on the main river with similar structures on the tributaries, as was done. However, considerable departure from the adopted plan would have been possible within the directive by Congress, and the Tennessee Valley Authority deserves great credit for the choice it made.

The Corps of Engineers is likewise deserving of high credit for having prepared basic plans with such thoroughness that work could be undertaken by TVA without long delays at the start. The TVA Board, in its report to Congress in 1936 on the Unified Development of the Tennessee River, appropriately acknowledged that TVA was "much indebted" to the Corps for the 308 Report, which had been "of great value," it said, in preparing its own development plans.

A spirit of teamwork has continued between these two agencies of government throughout their association, and as an officer retired from the Corps of Engineers and now working with TVA, I have observed this close cooperation with pleasure.

Other river development projects

While the Tennessee Valley development has been notable for many things, including its magnitude, there are other multipurpose systems which will eventually exceed it in size. One of these, perhaps the largest of all, is the Columbia River Basin system, now under development by the Corps of Engineers and the Bureau of Reclamation. The former has built Bonneville and McNary Dams, is at work on The Dalles, and dedicated Chief Joseph Dam on June 12. Grand Coulee was built by the Bureau of Reclamation. The Missouri River Valley, too, greatly exceeds the Tennessee Valley in area, and here the Army Engineers have made a start on complete multipurpose development with such huge dams as Fort Peck, Garrison, Oahe, Randall, and Gavins Point. The Central Valley Project in California is another large multipurpose development; and Congress has recently authorized several large multipurpose projects on the upper Colorado River to supplement those already built on the lower river, including Hoover, Davis, Parker, and Imperial Dams.

In emphasizing these monumental multipurpose projects, which by their very size require federal participation, we should not lose sight of a smaller project which by virtue of being more or less a pioneer in multipurpose operation deserves mention in any discussion of this subject. I refer to the Sacandaga Reservoir in the Hudson River Basin, designed and built by Edward H. Sargent, M. ASCE, Chief Engineer of the Hudson River Regulating District. Starting in 1930, this reservoir has been operated continuously for flood control and low-flow regulation as well as for power. Built at a cost of only $12 million, which is allocated 95 percent to power and 5 percent to flood control, and equipped with only two 12,500-kva hydroelectric units, this project is nevertheless notable for the daring of the engineer in pioneering in a still undeveloped field. Incidentally, Mr. Sargent made a contribution to engineering progress by writing up his project thoroughly for CIVIL ENGINEERING as far back as 1938 [November 1938 issue].

As a matter of fact, many engineers have been liberal in sharing their experiences on multipurpose projects with the profession through their writings, many of which have appeared in CIVIL ENGINEERING and the *ASCE Proceedings*. A symposium on multipurpose reservoirs, sponsored by ASCE's Hydraulics Division, was conducted by a joint committee on design and operation of multipurpose reservoirs following its inauguration in September 1945, and the six Technical Divisions represented on that committee all contributed generously to the *Transactions* of the Society.

While it is impossible here to mention more than a few of the many engineers who have led in multipurpose development, I want at least to pay tribute to those who have been most responsible for the engineering of the multipurpose development in the Tennessee Valley. I refer especially to Dr. A. E. Morgan, Hon. M. ASCE, first Chairman of the TVA Board and Chief Engineer; his successors, the late Theodore B. Parker and C. E. Blee; and the late Sherman M. Woodward, first Water Control Planning Engineer, who was succeeded in turn by James S. Bowman and Reed A. Elliot. (All are members of ASCE.) All these men helped in the making of engineering history, but their rewards have not in any case been great. It is hoped that the gratitude of future generations will bring to each the kind of satisfaction that results from a knowledge of work well done.

What does the future hold?

Just what the future holds for multipurpose development is difficult to predict. The coming needs can probably be seen most clearly in the Southwest, where a growing demand for water stems from the requirements of swelling cities and expanding industry. With limited rainfall falling on relatively flat terrain and absorbent soil, it will be increasingly necessary to make the maximum use of every available dam site. Here, too, irrigation is of great importance, and the amount of water required for that purpose may exceed all other needs.

Under Presidential guidance much progress has been made recently in stimulating coordination among the agencies of government most concerned with resource development in the western regions. The Bureau of Reclamation, the Department of Agriculture, and the Corps of Engineers are working together in closer cooperation today than ever before, and the same spirit of teamwork has been developed in their work with other federal agencies and the interested states. The report made recently by the Arkansas-White-Red Basins Interagency Committee is evidence of what can be accomplished toward the unified development of river basins when organizations resolve to work together.

The future, moreover, holds a great challenge to the civil engineer. This challenge is first of all technical in nature, taxing his skill, his ingenuity, and his vision. But it is also a challenge of a deeper sort, for many of the resource developments important to our country's future depend on decisions of Government requiring engineering judgment. These decisions must be made by Congress and by the executive branch, or by state and local governments down the line. It is an obligation of engineers, and of engineering societies such as ASCE, to be alert to the public need and to see that the right decisions are made at the right time.

(This article is a shortened form of the paper presented by General Vogel at the ASCE Knoxville Convention, in the Symposium on Multiple-Purpose River Development, before the General Technical Session presided over by C. E. Blee, Chief Engineer of the TVA.)

Success of the TVA multiple-purpose river development

In my view, the success of the TVA multiple-purpose undertaking lies as much in its organization, in its democratic processes, and in the cooperation between federal, state, and local governments, as in the construction and operating features which are primarily of interest to the engineer. In both its form of organization and the breadth of its responsibilities, TVA is unique and when established was experimental. TVA was endowed with corporate form; it was granted the broad administrative flexibility normally associated with private business but infrequently found in government. Here for the first time the Federal Government placed in a single regional agency responsibility for its interest in the unified development of all the natural resources of a region.

One of the significant results of the TVA experience is the example it offers of the manner in which the Federal Government can help to develop the resources of a large region within the framework of democracy, so that individual initiative and enterprise will prosper.

In 1933 the Tennessee Valley was a region abundant in natural resources which were mostly underdeveloped. The Tennessee River was a major resource but its potential was being wasted; in times of flood it brought great damage; the cycle of flood and drought made navigation impracticable. Other natural resources, particularly forests and agricultural lands, were being used but in such a manner as to deplete and waste them.

The Tennessee River was the principal resource to be developed directly by TVA, for the magnitude of that undertaking was beyond either private or state and local capabilities. The river has now been brought under virtual control; major floods have been effectively regulated; a navigation channel connecting to the nation's inland waterway system has been provided; and the water which before ran unused to the sea generates power for the homes, farms, businesses, and industries of the region.

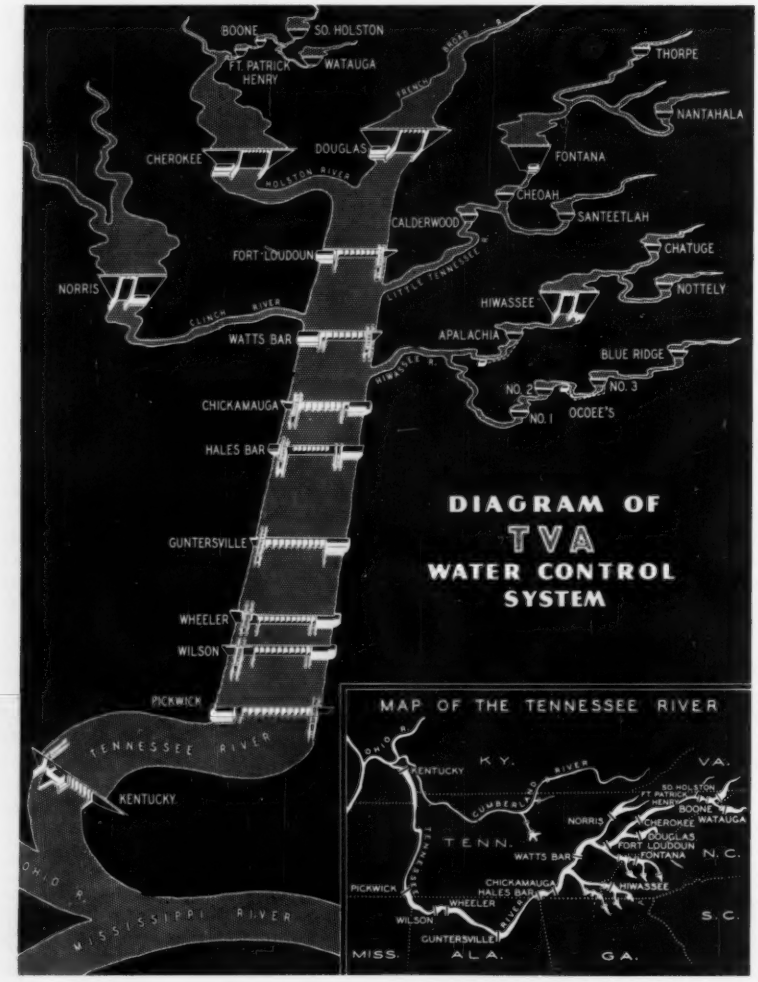


FIG. 1. TVA water control system provides nearly 12 million acre-ft of storage capacity for flood control alone, navigation channel 650 miles long with only ten locks, and installed hydro capacity of 3 ½ million kw. Area of 80,000 sq miles is served with TVA power.

Navigation channel 650 miles long

The nine multipurpose dams on the main stream (Fig. 1) aided by regulation from the many storage dams on the tributaries, provide a year-round 650-mile, 9-ft navigation channel, extending from the mouth of the river near Paducah, Ky., to Knoxville, Tenn.

G. O. WESSENAUER, A.M. ASCE

Manager of Power,

Tennessee Valley Authority,

Chattanooga, Tenn.

This channel connects with the 10,000-mile inland waterway system which centers on the Mississippi River.

In 1933, the year TVA was created, traffic on the Tennessee River was a mere 33 million ton-miles, mostly sand and gravel moving short distances. This past year (1955) traffic totaled $1^1/_2$ billion ton-miles—45 times the 1933 figure. Coal moving to TVA's steam plants is the largest single item carried on the river and the fastest growing. Other cargoes include oil and gasoline, grain and grain products, iron and steel products, chemicals, forest products, automobiles, and fertilizer.

Annual costs incurred both by TVA, the U.S. Coast Guard, and the Corps of Engineers in operating and maintaining the navigation channel, including depreciation of TVA's investment in navigation facilities, totaled $3.9 million in the fiscal year 1955. Savings to shippers located in the region and elsewhere now average about $15 million a year. The savings—or benefits—clearly exceed the annual cost. In fact, the difference between cost and savings corresponds to an 8-percent return on the depreciated investment of $140 million in TVA navigation facilities.

The cost of the navigation channel on the Tennessee is about $240,000 a mile, less than on many other rivers, partly because the investment has been shared with power and flood control. So many variables affect this cost that any comparison with other river systems has definite limitations. The purchasing power of the dollar at the time the facilities are built, the character and length of the channel, and the fall in the river are some of the factors affecting cost. It is nevertheless interesting that the investment in the upper Mississippi River navigation channel, of which the time of construction, length, and fall are about the same as for the Tennessee, is approximately $280,000 a mile.

Flood control—a primary objective

In the operation of TVA's reservoirs, flood control is a primary objective. Before the flood season, the reservoirs are drawn down to provide nearly 12 million acre-ft of storage capacity. To ensure that the control operations will follow the planning and design on which the system is based, a guide curve is established for each reservoir, the shape of the curve depending largely on the need for flood regulation.

This curve prescribes the elevation to which each reservoir must be lowered by January 1, near the start of the flood season. The main river reservoirs are held throughout the flood season at the January 1 level which, of course, must not be less than that required to provide navigation depths. The tributary reservoirs, however, are allowed to fill partially prior to March 15, as the probability of occurrence of a succession of large floods decreases. From March 15 to April 1, the tributary reservoirs are allowed to fill at a more rapid rate. After April 1, when most of the critical flood danger is passed, all the reservoirs fill to normal summer levels as rapidly as runoff permits. During the dry season in the late summer and fall, the water which was stored in the spring is released through the turbines to generate electricity and sustain river flows. Usually this release is sufficient to draw the reservoir below the prescribed January 1 level; if not, gate discharge is begun to assure that the necessary flood storage space will be available on that date. In some years, water which would produce several million dollars worth of power has to be spilled.

The TVA Act specified that the dams and reservoirs were to be designed to regulate the waters of the Tennessee River, not alone to protect the Tennessee Valley from floods but also to help protect the lower Ohio and Mississippi. During 1946, 1947, and 1948, heavy rainfall would have caused the fifth, sixth, and seventh highest floods of record at Chattanooga had it not been for TVA's reservoirs, which reduced these floods below damaging levels. In the past 20 years, some 24 floods on the Mississippi River which would have exceeded a flood stage of 40 ft at Cairo, Ill., have been lowered by amounts varying from a few tenths of a foot to 2 ft. It has been estimated that the present TVA system can reduce the most dangerous floods on the lower Ohio and Mississippi by as much as 2 to 3 ft, depending on type and size of flood in the Tennessee River at the time.

The annual benefits from the flood control system already provided by TVA average about $11 million, more than half of which is outside the Tennes-

Value of recreation facilities on TVA lake frontage was more than 53 million dollars at end of 1955, survey showed. Except for visitor facilities at dams and other projects, TVA no longer operates recreational facilities as such, leaving them to state, local, and private agencies. Here Kentucky Lake State Park is shown.

see Valley. The annual cost of operation and maintenance and depreciation on TVA's flood control facilities is about $2.6 million. The annual benefits exceed the annual costs by a margin which represents a return of 4½ to 5 percent annually on the depreciated flood control investment of $168 million.

The cost to the Government of providing flood control in the Tennessee Valley—just under $16 an acre-ft—has been less than that for many other river basins. Recognizing the limitations in such comparisons, this cost is less than half the average of $36 per acre-ft provided in reservoirs elsewhere in the Ohio River basin and $91 an acre-ft for several projects in the northeastern states.

In the Tennessee Valley there remain important areas in which the TVA system does not, and cannot, fully protect local communities from maximum floods without local protective works. The Federal Government requires local communities to assume a share of the responsibility for providing flood control levees. As yet, Chattanooga, which lies in the flood plain, has not initiated its part of such a project. Many other communities, situated above the storage reservoirs or on streams that are as yet uncontrolled, have local flood problems. Local flood protection is not a multipurpose activity nor primarily a federal responsibility, but TVA is encouraging the local communities to take the action called for to solve this problem.

Power—many achievements

The multipurpose projects constructed by TVA are inseparably a part of its entire power system, which includes the single-purpose power dams built or acquired by TVA, the power dams built and operated by the Aluminum Company of America, the multipurpose dams built on the Cumberland River by the Corps of Engineers, and the thermal plants purchased and constructed by TVA.

The total installed capacity of the multipurpose projects on the Tennessee River system is about 2½ million kw, and that of the combined system—including the Alcoa and Cumberland projects and TVA's single-purpose power dams—is 3½ million kw. These hydro plants are capable of producing in an average year about 16 billion kwhr. The capacity of the thermal plants now in operation or under construction by TVA totals nearly 6½ million kw. The system will shortly have a total installed generating capacity in excess of 10 million kw. Additional capacity is planned, most of it in thermal plants, because the hydro potentialities of the region have been largely developed.

In the early years of TVA, when the potential hydro capacity was sufficient to meet the growing power requirements of the region, the few thermal plants were used primarily as supplements. Today, of course, they are necessary to assist in carrying the base loads. This sequence of power development is likely to occur in any region, no matter how great its hydroelectric resources may be. Sooner or later, thermal power will be needed to supplement hydro. There is no question but that the usefulness to the Government of its investment in multipurpose hydro projects has been materially enhanced through TVA's ownership of thermal plants.

Let me enumerate briefly a few achievements which measure the progress TVA has made toward the goals set forth for it by Congress. In the 80,000 sq miles served with TVA power there are 1.4 million electric consumers, where in 1933 there were fewer than 300,000. Where then only 3 percent of the farms were served with electricity, today more than 90 percent are so served. Residential electric use in 1933 followed the national pattern and averaged barely 600 kwhr per year; today it is more than 5,500 kwhr, about double the national average, and retail rates to the ultimate consumer average about a third less than the national average. In a region that consumed barely 1½ billion kwhr in 1933, we now find total use nearing 60 billion kwhr a year.

Since the TVA program produces direct revenues for the Government, let me apply the usual measures of revenues, expenses, and earnings to show that it is a financial success. During the fiscal year 1955, TVA's power revenue totaled $188 million; operating and maintenance expenses, including state and local tax equivalents, $110 million; depreciation expense, $30 million; and net operating revenue, $48 million. During the year, the investment in power facilities, less depreciation reserves, averaged $1,130,000,000, making the return on the investment 4¼ percent. Over the 22 years of TVA's power operations, this return has averaged 4 percent.

While the revenues and earnings of TVA's power program, and of any Government power program, may be a suitable measure of the adequacy of the electric rates charged the customer, they are not the true measure of the benefits. The indirect benefits from the development of an otherwise wasted resource and the resulting conservation of fuels which are not replenishable, are significant factors, even though difficult to measure in dollars and cents. Furthermore, our Government has adopted the policy of pricing its power as low as possible with the result that actual earnings are deliberately held at a moderate to low level. There is a fundamental difference between testing the pricing policy and appraising the real value of the products sold under the policy.

National defense was one of the primary objectives of the TVA Act, and TVA's power program has contributed substantially to this aim. More than half of all the electric energy that TVA sold last year went to defense agencies of the Federal Government, particularly the Atomic Energy Commission. During the present fiscal year TVA expects to deliver more than 31 billion kwhr to the Federal Government—more power than the total sold in any but a few of the 48 states.

Other benefits

In addition to navigation, flood control, power, and national defense, the multipurpose facilities have resulted in many secondary benefits. Malaria has been intensively studied and virtually eradicated from the region. Domestic and industrial stream pollution has been abated. At a number of municipal water works located below TVA reservoirs, bacterial concentrations have been reduced over 90 percent by the purifying influences of the impoundments. Use of the TVA lakes and shoreline for recreation has grown into a thriving business and is providing healthful pursuits for literally millions of people. Except for visitor facilities at the dams and other projects, TVA no longer provides recreational facilities as such, leaving these developments to state, local, and private agencies. Recreation on the TVA lakes is a multimillion-dollar business.

The multipurpose dams and reservoirs are contributing to the industrial development of the region. The ample and dependable supply of fresh water, the low-cost navigation channel, the low-cost power, and the reasonable freedom from flood or extreme fluctuation in water level provide an attractive environment for industry.

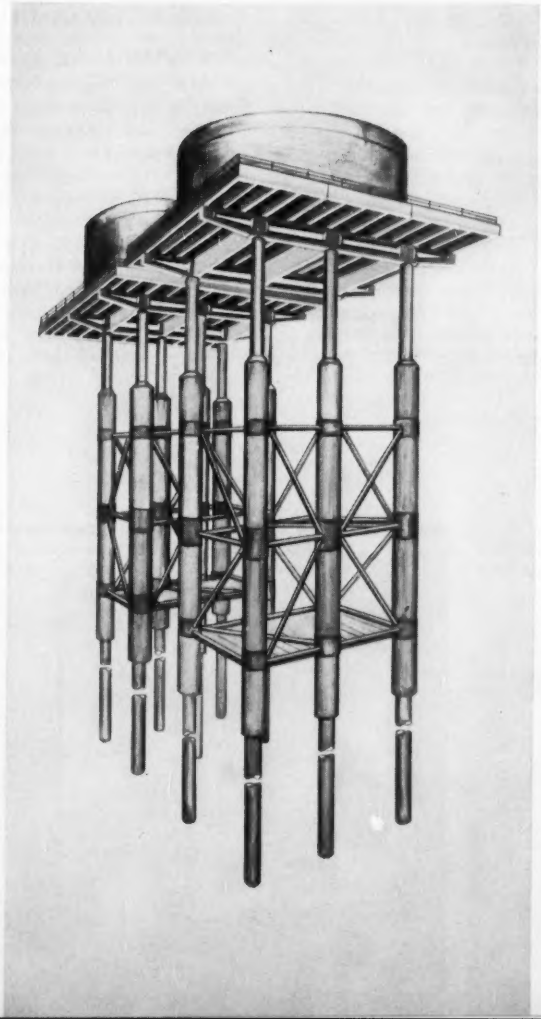
For twenty years now, since the beginning of reservoir regulation in 1936, the TVA system has been operated as planned through severe droughts and major flood conditions. The undertaking has proved successful, and visitors from other parts of this nation and from many parts of the world come each year to TVA to determine how the experience of this valley can be adapted to the valleys in which they live.

(This article is a shortened form of the paper presented by Mr. Wessenauer at the ASCE Knoxville Convention, in the Symposium on Multiple-Purpose River Development, before the General Technical Session, presided over by C. E. Blee, Chief Engineer of the TVA.)

ROBERT N. BRUCE, JR., J.M. ASCE

Engineer, Raymond Concrete Pile Co., Brussels, Belgium

PRESTRESSED PRECAST PLATFORM BUILT IN GULF

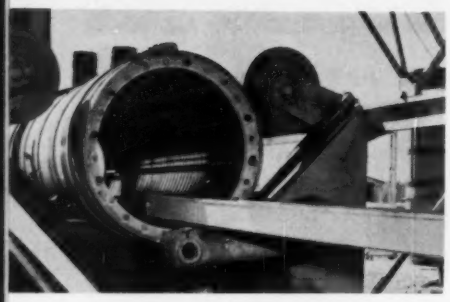


As the search for oil moves further out to sea, the pressure on our ingenuity grows. Now, 35 miles offshore we have the first all-prestressed, all-prefabricated platform erected in the Gulf of Mexico. This platform, built for the Magnolia Petroleum Co., supports two 5,000-barrel tanks on a prestressed deck supported on spun, prestressed hollow piles. Some of these piles are 192 ft long. The structure is designed to withstand the force of maximum hurricane winds of 150 miles per hour (mph) and a maximum wave force of 750 lb per sq ft (psf). It stands in water 37 ft deep, 41 ft above mean high water.

The platform is composed of three main elements—the bearing piles, the two jackets for bracing, and the superstructure. The construction sequence was first to sink the jacket frame at the site, then to drive the bearing piles through the hollow legs of the jacket,

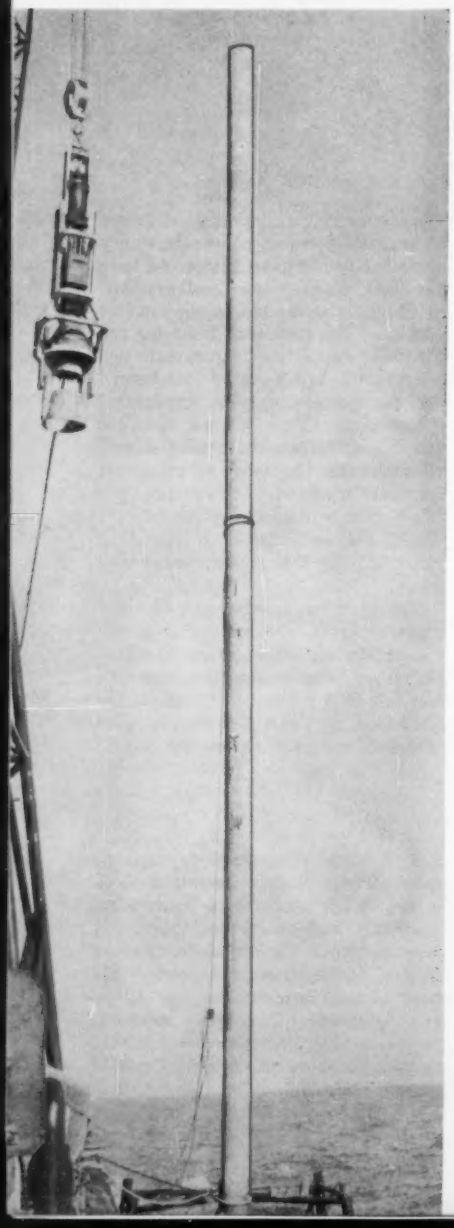
FIG. 1. First all-prestressed, prefabricated offshore platform consists of three main parts—jacket structure (heavy piles, diagonally braced), bearing piles, and superstructure. Timber platforms near base of jacket structure supported this structure until bearing piles were driven and concreted. Completed structure, shown in photo, supports two 5,000-bbl tanks for offshore oil storage. Depth of water at site is 37 ft.

(Vol. p. 441)



Both 36-in. and 54-in. piles were centrifugally spun in 16-ft sections. Arm in foreground feeds concrete to spinning form.

Pile of 36-in. diameter and 192 ft long, stands unsupported 170 ft above mud line. Test pile successfully supported 450 tons with net settlement of 0.094 in.



and finally to place the girders and deck on which the tanks will stand.

These tanks are used as offshore production-gathering facilities. In other words, oil produced from several wells in this particular offshore field is piped to these storage tanks, where it is gathered and stored temporarily before being piped in to shore through an offshore pipeline.

Jacket structure

The main elements of the jacket structure are the prestressed concrete pipe piles of 54-in. outside diameter, with walls 4 in. thick. There are six of these piles in each of the two jacket structures. The piles are braced horizontally and diagonally by steel pipe, which is welded to steel bands cast integrally in the concrete pipe. After the jackets were completely assembled, all exposed steel bands and bracing were coated with concrete.

The concrete pipe was cast in a Cen-Vi-Ro machine which centrifugally produces a dense concrete that can be stripped from the form in 12 hours. Rubber mandrels are placed in the form prior to pouring and removed after the concrete has set, thus producing the holes for the prestressing cables. Any number of 16-ft sections can be placed end to end and prestressed to form a continuous member. After the cables are grouted, the end anchorages are removed. (See "Prestressing Warrants Study to Simplify Construction Methods," by Maxwell M. Upson, M. ASCE, CIVIL ENGINEERING, January 1953.)

The cylinder piles that make up the jacket structure are prestressed by 12 cables each. Each cable, consisting of twelve No. 6 MB oil-tempered wires, was initially tensioned to 150,000 psi. A residual stress of 120,000 psi was assumed in design. The jacket assemblies, weighing 230 tons each, were fabricated on land, assembled on barges, and towed to location, where the lifting and placing operation was accomplished by means of heavy-duty floating equipment. Heavy timbers were strapped to the lower level of the pipe bracing to create a type of spread foundation which temporarily carried the weight of the jacket structure. It should be mentioned that even with such extremely heavy units, and with the 6-ft ground swells common in the Gulf of Mexico, the jacket assemblies were set so accurately that they were within $1^1/_2$ in. of the plan location.

After the jacket assemblies were set, the cylinder piles of 36 in. outside diameter, fabricated in the same way as the 54-in. piles, were driven down inside the 54-in. piles. Piles were driven with a Raymond 000 hammer having a 12,500-lb ram with an adjustable 24-in. or 39-in. stroke. When the piles had been driven to the required resistance, the annular spaces between the 36-in. and the 54-in. piles were grouted, thus transferring the weight of the jacket structure to the bearing piles. The maximum required penetration was estimated to be 108 ft.

Superstructure

After they were cut off at grade, the bearing piles were ready to receive the girder and tie-beam units. Girders were designed with an I-section 30 in. wide and 48 in. deep, with a web thickness of 10 in. Each girder was designed as a continuous member over three supports (Fig. 2) and was post-tensioned with 16 Raycables of twelve No. 6 MB oil-tempered wires each. Initial tension was 150,000 psi, and a 20-percent stress loss was assumed. The prestressing cable was prefabri-

Two jacket structures were completely fabricated on shore, then towed to site. Each unit weighs 230 tons.

cated into cages and the cages were then placed in the wooden girder forms. A small amount of conventional reinforcement was used.

Cables were post-tensioned with Freyssinet jacks simultaneously from both ends, thus reducing some of the friction losses caused by the five reverse curves in the design. Girders, in pairs, were then assembled into larger units by conventional reinforced concrete tie-beams. The girder and tie-beam units, weighing 74 tons each, were transported by barge to the site, where they were lifted and set on the bearing piles. The girders were fixed to the piles by poured-in-place concrete plugs and steel dowels.

Concrete slabs, prestressed in one direction, were used for decking. Slab sections were 16 ft 8 in. wide and 48 ft 0 in. long, with a cross section as shown in Fig. 2. Each slab was stressed by 30 Raycables, of twelve No. 6 MB oil-tempered wires each, initially tensioned to 150,000 psi. The concrete used in the girders and slabs developed a 28-day compressive strength of 5,000 psi. Slabs were designed as simple supported beams cantilevered at both ends, with the cables curving downward at mid-span. Slab panels, weighing 64 tons each, were transported to location and set in place on the girders. Connections were made by dowels grouted in place.

This pioneer type of platform was created to serve an industry that desires structures with a long life and the ability to withstand the forces of the sea.

Owner of the structure is Magnolia Petroleum Company. The general contractor was J. Ray McDermott, Inc., of Harvey, La., and the component parts were fabricated by Gulf Prestressed Concrete Products of Morgan City, La. The entire structure was designed by the Raymond Concrete Pile Company of New York, N.Y.

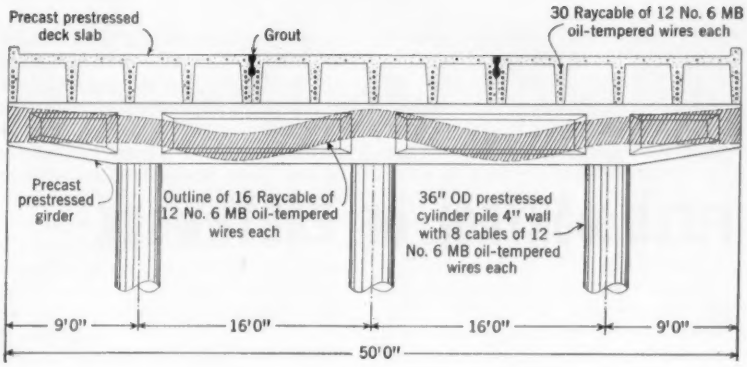
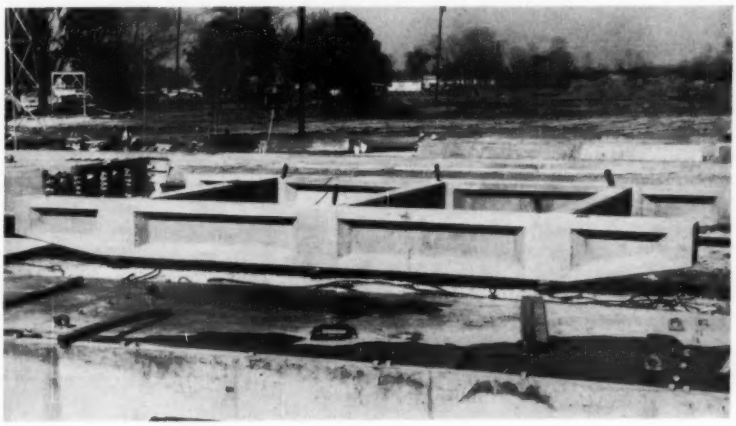
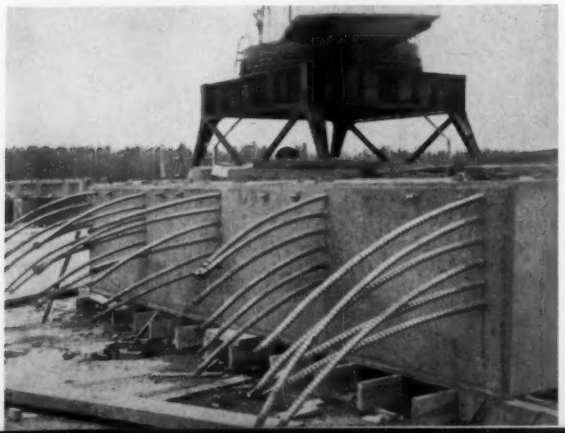

Precast prestressed deck slab
Grout
30 Raycable of 12 No. 6 MB oil-tempered wires each
Precast prestressed girder
Outline of 16 Raycable of 12 No. 6 MB oil-tempered wires each
36" OD prestressed cylinder pile 4" wall with 8 cables of 12 No. 6 MB oil-tempered wires each
9'0"
16'0"
16'0"
9'0"
50'0"

FIG. 2. Girders and deck slab are prestressed by cables arranged as shown in this detail of superstructure.



Prestressed girders were cast and stressed individually, then connected by conventionally reinforced concrete diaphragms. Entire unit weighs 74 tons.

Deck slab is prestressed with 30 Raycables to design stress of 120,000 psi. Slab concrete developed 28-day strength of 5,000 psi.



Derrick barge sets first 64-ton deck slab on girder assembly Slab is doweled to girder.

FIELD CONTROL OF EARTHWORK

How to keep up with the contractor on fast-moving freeway construction

PAUL K. GARBER, A.M. ASCE

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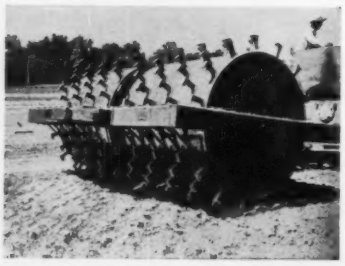
In modern highway design, flat grades and limited curvature have made earthwork the major single item in quantity, and frequently in dollar value. Numerous contractors, equipped with large-capacity earth-moving equipment, are capable of moving 20,000 to 30,000 cu yd of earth a day on very short notice. The equipment industry has kept pace with this expansion and there has been very little increase in the cost of earthwork construction.

On the other hand, the engineering approach to the control of earthwork has remained essentially unchanged for the past 20 years. Our specifications, field organizations, and basic control tests simply do not anticipate present construction practices. Like it or not the engineer must be able to gear his operations to the contractor's if the economic possibilities of large-scale operations are to be fully realized. Reactivation of the committee on earthmoving equipment by the Highway Research Board is an indication of the widespread dissatisfaction with our present approach. This problem is especially pertinent in view of the impending highway construction program.

In the following discussion, the word "freeway" is used to designate the modern limited-access rural highway, having controlled grades and curvature, constructed on an expedited schedule.

Are the specifications adequate?

There is an understandable desire on the part of local authorities and engi-



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Inspector can determine proper compaction by visual observation. For sheepsfoot rollers, three photos illustrate: (1) lift that is too dry, so that roller "walks out" after two or three passes; (2) lift that is so wet that roller will never "walk out"; and (3) lift that is just right, so

neers to make full use of existing state highway specifications, normally the product of many years of experience. However, the factors which contributed to their success may not be present on the expedited construction of limited-access facilities. Three of the more important factors, with respect to control of earthwork operations, will be discussed.

1. *Are the specifications adequate for the basic design involved?* This question cannot be easily resolved unless the state has had previous experience with similar projects. Lacking such experience, it is not reasonable to expect outstanding success with existing specifications, particularly in areas of rough topography, or in areas that are inherently unstable and would normally be avoided. Certainly such problems as compaction, stability, settlement, and underdrainage become much more severe as embankment height or cut depth is increased to achieve flat grades and straight alignment.

2. *Do the specifications make efficient use of engineering manpower?* It should be recognized that it is not possible to assemble a supervisory organization, either private or governmental, for an expedited freeway that is collectively comparable to the state highway organization of years past. It will be another ten years before we have available engineers with 30 years of experience in freeway construction.

A freeway is not just another four-lane road with a fence on both sides. Practically all existing specifications are at fault in some respect as regards earthwork construction controls. Most specifications do not anticipate the magnitude and speed of the operations involved and hamper both the engineer and the contractor with many restrictive, obsolete, and arbitrary clauses. The items of work covered by these clauses may actually become relatively insignificant as the volume of earthwork increases. This can be estimated on the basis of the number of pay items involved.

For example, consider one project where the grading and drainage contract amounted to about $2,200,000 and the monthly pay estimate amounted to a tabulation of some 81 items which included 5 items of excavation, 8 items of manipulation, and 5 of watering and rolling. These items were measured by stations, cubic yards, ton miles, square yards, hours, and millions of gallons. Of these 81 items, the total value of 27 items was less than $1,000 each, and the value of 9 items was less than $100 each. In other words, the total value of one-third of the items of work amounted to less than 1 percent of the total value of the contract. The contract for this work covered one construction season. The engineering cost of evaluating these items on a monthly basis amounts to more than the value of construction on one-third of the items and certainly does not constitute efficient use of engineering manpower.

3. *Do the specifications inherently assume a standing or existing contractor-engineer relationship?* This question can be answered by discussion of the problem with local contractors' associations. It is entirely possible that existing specifications are vague on many items of work while at the same time there is a common interpretation of these items on state highway work that is not apparent to an outsider.

Some of the more common items in this category have to do with unacceptable work. The specifications are normally very clear on what constitutes acceptable work but seldom give supervisory personnel a clear measure of what constitutes unacceptable work. This is not possible in some cases, but there are many items of work that could be better defined. I prefer an approach similar to that occasionally applied to pipe inspection, that is, 20 percent failure of test results is sufficient grounds for rejection of all production (or work) represented by the tests.

Is the organization effective?

For a good many years, the common practice among engineers has been to organize field supervision around one individual, the resident engineer, who is assigned to one project or a given length of the project. This has carried over into modern construction supervision, so that a typical field organization might be represented by Fig. 1 (*a*). In spite of the simplicity of the organization, the resident engineer must be all things to all people—not only to

6

4

5

that roller will walk out to within 2 in. of surface after six passes. For rubber-tired equipment, three photos show: (4) lift that is too dry; (5) lift that is too wet; and (6) lift that is just right after six passes of rubber-tired vehicle.

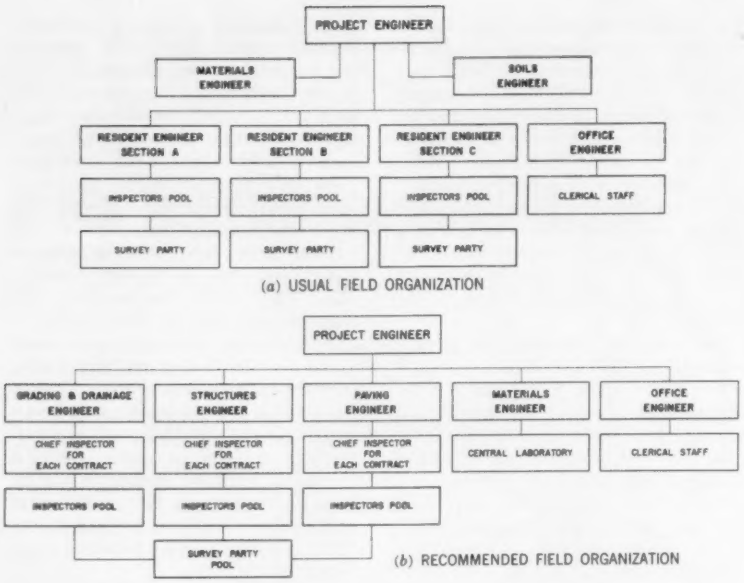


FIG. 1. Organization charts for field supervisory personnel show usual type of organization (a), contrasted with recommended type (b). In recommended setup, one man is responsible for each major *type of construction* on the project instead of having one man, a resident engineer, responsible for all work within a *given area*, as in the usual type of field organization.

his own organization but to all contractors working on the project. This is practically impossible in this day of specialized engineering and is shamefully inefficient and productive of delays, for both the engineer's client and the contractor.

Since contractors have become generally specialized in the categories of grading and drainage, structures, and paving, it would seem logical to subdivide the supervisory engineering forces into the same categories, somewhat as shown in Fig. 1 (*b*). This would achieve better liaison with the contractors and make better use of available engineering personnel, who are not normally experienced in all phases of the work. In effect, it makes one man responsible for each major type of construction on the project instead of making one man responsible for all work within a given area. Further, it assigns a junior engineer or chief inspector and an inspection team to each major contractor—the basic supervisory unit of the organization. The inspection team should be trained, equipped, and operated as a specialized unit.

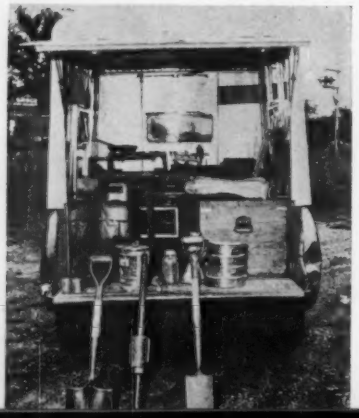
Such an organization is practically mandatory for efficient control of earthwork operations. Too often, the soils engineer is put in a position where he acts only in an advisory capacity. In such cases, faulty earthwork construction is frequently buried before he can act through the "chain of command." Also, it is only human for the resident engineer to take particular interest in some particular type of construction, in which case all other types suffer as a consequence. Almost invariably it is the earthwork that suffers. This result and its embarrassing consequences can be avoided only if the training and command of earthwork inspection forces are the direct responsibility of a qualified soils engineer.

Further, efficient inspection cannot be obtained unless the field forces are as mobile as are the contractor's forces. The basic supervisory unit should have at least two vehicles and, on large projects, these vehicles should be equipped with field radios. The annual cost of mobile radios and a central station for the entire organization has been decreasing yearly and now is roughly equivalent to the annual salary of one junior engineer. The comparative savings are obvious.

One of the vehicles should be permanently assigned to the chief inspector, and for soils work should preferably be a pickup truck for transportation of large samples. It should have a weathertight box behind the cab for plans and data forms.

The other vehicle should be a mobile laboratory to be used by the soils in-

To keep up with fast-moving construction forces on modern freeways, field supervisory organization should have at least two vehicles. One should be for chief inspector, preferably a pickup truck capable of transporting large samples (not shown). The other should be a mobile laboratory for soils inspectors, such as that shown in photo below. Among equipment recommended for rapid determination of soil density is drive sampler shown standing between two spades in photo, and in Fig. 2 at right.



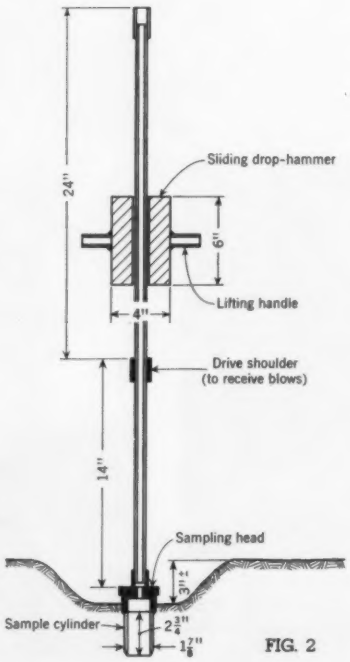


FIG. 2

spectors. It should contain all the equipment necessary for the sampling and field testing of soils, including samples, scales, and butane gas stove. On most projects the density sampling of fine-grained soils can be accelerated by including in this equipment a drive sampler of the type shown in Fig. 2 and in the photograph of a typical mobile laboratory. Properly equipped, such a mobile laboratory can supervise the grading operations of at least one contractor, including several grading "spreads" and pipe backfill operations. This vehicle should not be assigned to any one individual since it will commonly be required on the job two shifts a day.

Of course the mobile laboratory cannot efficiently perform such classification tests as the Atterberg Limits or secondary tests such as compaction. Representative samples for such tests should be taken to a central laboratory by the chief inspector.

Is supervisory force properly trained?

Even with the best specifications, organization, and equipment, field supervisory forces are seldom prepared for the impact of earthwork construction operations. It is not uncommon for a modern grading contractor to be in full-scale operation within a matter of days. The earthwork inspectors must, of necessity, be relatively scattered and operate with more independence and responsibility than their counterparts on bridges or paving. The inspector in this position starts at a disadvantage since it is probable that the field experience of the contractor's grading foreman exceeds his to a truly awesome extent.

This preliminary disadvantage may be only psychological in most cases, but it can be a detriment to the orderly control of the work. Further, the completely inexperienced inspectors may have an excellent grasp of field sampling and testing techniques but, at the same time, be completely unprepared to take decisive action on the many daily minor crises that arise and are not covered by the "book." There is no rigorous solution for this problem except experience. There are, however, several steps that can be taken to counteract the deficiency of experience at the inspection level.

First, on major grading projects, a test embankment section can be constructed as the first order of work. This embankment, or "test fill," should be located so that it can be constructed of the one or two principal soil types in the contract. The primary purpose of the test fill is to train the inspection team in the use of their equipment and

Inexperienced inspectors can get quick training by means of photographs showing "do's" and "don'ts" of earthwork construction. Here a special problem is illustrated—crack in macadam shoulder accompanied by movement of subgrade out from under pavement slab, as a consequence of imperfect compaction of backfill over a pipe culvert.

Major problem in subgrade construction is not how to secure uniform density and water content, but how to make that condition permanent. Poor surface drainage often causes loss of compaction. Three conditions of subgrade maintenance ranging from good to horrible are seen above.

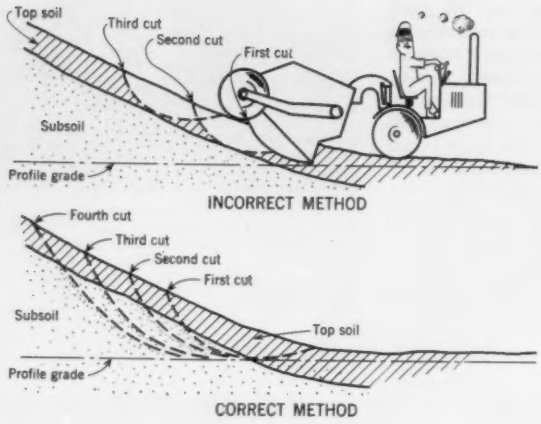


FIG. 3. In removing soil for use in embankments, top soil should be blended with subsoil to obtain suitable mixture.

to provide a visual example of field compaction techniques ranging from good to bad for the type of equipment to be used on the job. If intelligible test results are obtained, the test section will also provide a field compaction curve for each type of equipment.

A convenient test fill for each soil type consists of a working area of about 80 by 160 ft, plus side slopes and turnaround areas. The working area should be divided into two lanes, each say 40 ft wide and 160 ft long, and subdivided into sections about 40 ft long. The water content should be varied in the four sections from 4 to 6 percent below the laboratory optimum to about 6 percent above this optimum. One lane should be compacted with a typical rubber-tired roller and the other lane with a sheepsfoot roller. Compaction of the ground surface and four or five lifts (the last lift to be treated as subgrade) will give the inspectors a chance to observe and test a wide variety of roller operations and resulting compaction. Such a test fill can be constructed while the contractor is assembling the rest of his equipment.

Second, there is need for a specialized training program on the practical aspects of earthwork construction control. I have in mind a program similar to those offered on concrete paving construction by the Portland Cement Association. Although highly desirable, no such organization or service is likely to exist within the earthwork equipment industry for some time to come. As an alternative, it is the obligation of every field soils engineer in responsible charge of work to provide training programs for his inspection personnel. This can best be accomplished with illustrations, preferably photographs, depicting salient features of earthwork control. These can be used in conjunction with a manual or can be presented as slides accompanied by brief lectures.

Practically speaking this is not a simple proposition. A file of construction photographs will rarely contain the type of illustration needed. I would like to encourage all engineers to accumulate photographs showing the "do's" and "don'ts" of earthwork construction. The type of photograph needed is illustrated here by a few examples from my own files. These photographs are now being used in a manual prepared by Howard, Needles, Tammen & Bergendoff for the firm's own use at the inspection level. The following major subjects are covered.

Embankment construction. Modern, large-capacity earthmovers of the "scraper" type create a blend of soils by reason of the long pass necessary for loading. Soil-rock blends will commonly be obtained in areas of soft rock regardless of the type of excavation, and wherever possible these mixtures should be treated as soil in embankment and placed in lifts and compacted. It is highly desirable that top soil be blended with underlying soil prior to use in embankments, as shown in Fig. 3. The compaction characteristics of these blends cannot be predicted in advance of construction. During the time interval required to establish the compaction characteristics in the laboratory, the inspector must rely on his judgment. Field water content of the blend should be approximately equal to the plastic limit for proper compaction. Absolute determination of this water content is not required; it is only necessary for the inspector to determine relative water content by rolling out a $^1/_8$-in. thread of material. Further, proper compaction can be effectively determined by visual inspection, as illustrated by a group of six photographs [pages 44 and 45].

In embankment construction it is essential that a uniform condition be obtained. Areas subject to concentrated haul should be disked prior to rolling. Equipment should preferably be operated in such a manner that the most uniform coverage possible is obtained with the hauling equipment, with compaction equipment concentrating on areas of least coverage. Photos of well organized and poorly organized operations will be useful in the training program.

Excavation. The major problem in cut sections is water. Effective illustrations should be collected of various underseepage conditions corresponding to the types of permanent drainage treatment commonly used. Temporary dewatering by means of a pilot trench, to permit the use of soils in embankments, is of course a very effective construction expedient.

Subgrade. The major problem in subgrade construction is not how to obtain a uniform condition of density and water content, but how to maintain that condition. Loss of subgrade compaction often occurs as a consequence of poor surface drainage. Various conditions of subgrade maintenance and drainage ranging from good to horrible are illustrated in a group of three photographs [on preceding page]. The best practical control test for finished subgrade is the modern 50-ton rubber-tired roller. Two or three passes of this roller on the surface will detect more unstable areas than an infinite number of density and water-content tests.

Special problems. There are, of course, many special problems which can be most effectively described by means of photographs or other illustrations.

Some general factors in specifications, field organization, and control techniques which have a basic influence on the adequacy of supervision of modern earthwork operations have been outlined. Many other factors of course may have an equal influence on a given project. In any case, adequate supervision can be achieved on an economic basis only by eliminating those factors which are obsolete and insignificant in the light of modern earthwork construction techniques. We, as engineers, must be able to conduct our work as an integral part of the basic construction operation. The only alternatives are to discourage all future progress or to lose control of earthwork construction.

(This article is based on the paper presented by Mr. Garber at the ASCE Knoxville Convention, before the joint session of the Highway and Surveying and Mapping Divisions presided over by B. E. Beavin, chairman of the latter Division's Executive Committee.)

© Pennsylvania Railroad

Two trains carrying truck trailers on flat cars meet on Brilliant Bridge over Alleghany River at Pittsburgh on run between New York and Chicago. This type of "piggy-back" service is one of the outstanding results of the extensive research carried out by the railroads to improve their service.

Our railroads—a vital industry

HAL H. HALE, M. ASCE, Assistant to the Vice President, Association of American Railroads, Washington, D.C.

The rails pioneered in the development of the West and are continuing to pioneer in the modern development of our country—North, South, East and West. Around the year 1830 this country had 23 miles of railroad track. We reached the peak in railroad construction activity between 1880 and 1890.

It may be of interest to mention that the first President of the United States to ride on a railroad train was Andrew Jackson, who made his trip on June 6, 1833, on the lines of the present Baltimore & Ohio Railroad, between Ellicott's Mills and Baltimore, a distance of 13 miles.

Even the fabulous Davy Crockett, that "king of the wild frontier," rode on a railroad train. During his last term in Congress, in 1834, he had his first ride behind a locomotive. In his chronicles he says, "Our voyage down the Chesapeake Bay has very pleasant, and in a very short run we came to the place where we were to get on board of the railroad cars. This was a clean new sight to me; about a dozen big stages hung on to one machine. After a good deal of fuss, we all got seated and moved slowly off, the engine wheezing as if she had the tizzick. By and by she began to take short breaths, and away we went with a blue streak after us."

A lot of track has been laid since Davy and Andy made those journeys, and the problems of the industry have increased proportionately. The peak in mileage was reached in 1916, with an ownership of 254,037 miles of railroad line. Since that time the mileage has been dropping constantly, and by 1954 had been reduced to 221,098 miles. Approximately 29½ percent of all the world's railway mileage is in the United States.

The Class I railroads replaced their rails at an average rate of 2 million gross tons of rail per year between 1950 and 1954. Approximately 30 million cross-ties per year are required to meet their needs. The average investment value per mile of road is approximately $150,000.

Under Interstate Commerce Commission regulations of January 1, 1956, Class I railroads are classified as those having an annual operating revenue of three million dollars or more. All other railroads are identified as Class II, and these include many short-line railroads, industrial and port roads and switching railroads. It is of interest to know that the American Short Line Railroad Association, with headquarters in Washington, D. C., is composed of some 290 steam and electric railways and switching terminal companies in the United States. Its member roads range from one mile to nearly 2,400 miles in length. They have an aggregate investment of $2,229,000,000 and do an annual business of around $704,000,000. They form a very important element of our transportation system.

We in the railroad industry feel, as do many others, that the railroads are the backbone of American transportation. In the decade ending December 1954, the Class I railroads spent $10,476,099,000 for improvements to their properties—not including maintenance. Their average rate of return reached a peak in the years 1941 to 1945 of 4.97

© *Louisville and Nashville Railroad*

Oversize shipments are handled constantly by nation's railroads as a matter of course. Here 137-ft, 140,000-lb piece of oil-refinery equipment, requiring three flat cars, is ready to be moved to its destination.

© *Erie Railroad*

Railroads are constantly working to improve service and safety. Sonirail is used to detect rail flaws within joint-bar limits and on switch stock rail. Operating by sound waves, device gives off both visual and audible signals. It differs from similar device called Audigage in that, besides earphones, it has visible meter which reacts to tone changes.

percent, dropped sharply in 1946 to 2.75 percent, and has since varied upward and downward between these limits, with a return of 3.28 percent in 1954, and slightly over 4 percent in 1955. Compared with other private industry, this rate of return is far below that considered essential to the maintenance of healthy activity.

Railroads heavily taxed

It is estimated that in 1954 the payrolls of the Class I railroads approximated $4,855,000,000. This is private industry and private industry pays taxes. In the years 1950 to 1954, the Class I railroads of America paid approximately $1,141,000,000 a year in taxes. Their total revenue from freight, passenger, mail, express, and other services for 41 days in each of these years was required to pay federal, state, and local taxes. Many counties, municipalities and local units of government depend heavily on these taxes for the support of essential functions, such as schools, roads, health and welfare not to mention general governmental services. In many instances, this is one of the main, if not the most important, sources of taxation.

In contrast, major competitors of the railroads often contribute little in the form of local taxes since they move by air, highway or water, none of which is taxable and none of which represents industry ownership. Consider the case of one railroad in an Eastern county which enjoyed a substantial increase in its taxes because it beautified a local railroad station by planting shrubbery on the premises.

While railroads are essential to a sound peacetime economy, they are absolutely indispensable in time of war. To move an infantry division of 15,000 men and equipment, requires approximately 64 trains with a total of some 1,350 cars. In World War II, more than 97 percent of all troops, 90 percent of all Army equipment and supplies, and 90 percent of all Navy equipment and supplies were transported by rail. From December 1, 1941, to the end of August 1945, the railroads transported approximately 43,700,000 members of the armed forces. This total does not include many millions of trips made by individuals in the armed forces traveling singly or in small groups.

The railroads, individually and through the Association of American Railroads, are engaged in extensive economic, engineering and other research to improve their facilities. For example, research is constantly in progress on roadbed and track maintenance, continuous-welded rail, fatigue strength of structural welds, signals, automatic train control, grade-crossing protection, freight-car bearings, brakes, air conditioning, accident prevention, safe transportation of explosives and conservation of fuel and materials. Much of this research is conducted in our own laboratories. Other research is conducted in the laboratories of technological institutions and industry.

In grade-crossing protection alone—a subject of deep concern to us all—much progress has been made. In 1929, there were 2,485 deaths at railway-highway grade crossings. This was reduced to 1,303 in 1954. In that year, about 34 out of every 100 such accidents were caused by motor vehicles running into the sides of trains—often through gates into standing trains.

An outstanding example of the result of research is the "piggy-back" service much publicized in recent years. This is a popular name for the intercity transportation of motor truck trailers on specially equipped railway flatcars rather than over the public highways. While this form of service was established as early as 1937, its wide use has developed since 1950. Some 30 railroad systems in the United States and Canada are now providing such service and other railroads are preparing to do so. The railroads have invested millions of dollars in the construction and conversion of rolling stock, terminal facilities, and equipment to provide this type of service.

Do not assume that the railroads enjoy a monopoly in transportation. Far from it. They are fighting a constant battle to maintain the industry. There was a time, probably, when the railroads did enjoy such a monopoly, but the first 50 years of this century have seen a radical change in that situation.

Land grants paid back many times

Two transportation media in particular have enjoyed most favorable conditions in our lifetime—the airplane and the highway motor vehicle, and I should not exclude the waterway. These modes of transportation have enjoyed beneficent emolument, or a less desirable word, "subsidy" from the Federal Government. Now, before you tell me that the railroads enjoyed such benevolence, let me say that some roads did benefit when the Federal Government awarded them 131 million acres in land grants between 1850 and 1871. The value at that time was estimated to be 94 cents an acre, or around $123 million. This was done to encourage the construction of railroads in undeveloped territory, to

attract settlers and to enhance values, and it did do all those things.

Federal land grants were made to companies which built approximately 8 percent of the present railway mileage. Ninety-two percent of the present rail mileage received no such grants. In return, the roads receiving such grants and the roads competing with them, carried government troops and all government property used for military purposes for one-half of standard rates until October 1946. Prior to 1941, these lines carried government property used for non-military purposes for one-half of established rates. Also, until 1941, the land-grant railroads carried United States mails for four-fifths of standard rates.

In 1945, the Interstate Commerce Committee of the House of Representatives reported that these requirements had already returned to the government over $900 million in payment for the lands granted to the railroads. Between the time of that report and the end of land-grant deductions in government rates, additional benefits accrued to the Federal Government totaling $350 million. This is a grand total of approximately $1,250 million in benefits accuring to the government for the grant of $123 million in the beginning.

The American Railroads are private enterprise and they are merchants of transportation. This means that, as merchants, they must compete for business. To stay in business they must furnish transportation in an efficient manner and at a price that the customer will pay. They must meet all their obligations and attract and hold their investments. If they fail, they face one of two alternatives—bankruptcy or federal ownership. I do not believe that any sound-thinking person would want either of these. In the year 1953, from every dollar of operating revenue, the railroads paid 8.4 cents in taxes excluding payroll taxes, which are considered as wages. In addition, they paid out slightly more than 20 cents of each dollar so earned to own and maintain their right-of-way. These two items accounted for approximately 29 cents out of each dollar earned.

The movement of freight, as is well known, is the main source of railroad revenue. Let's take a look at one of our main competitors. The intercity common carrier trucking industry in the year 1953 paid out approximately 5.6 cents of each dollar of operating revenue in the form of taxes, including motor fuels and excise taxes and license fees but again excluding payroll taxes. They paid nothing as owners and maintainers of right-of-way. They operate on the highway, a publicly financed and maintained facility. Therefore, these two important items of cost, namely, taxes and ownership and maintenance of right-of-way, placed the two facilities in a relative demand position of 5.6 cents against approximately 29 cents of the revenue dollar—a ratio of about five to one.

Ask same ground rules for all

The railroad industry understands fully that the highway and the truck are here to stay. The railroad industry operates around 40,000 commercial-type highway vehicles, and its employees own and operate automobiles in about the same ratio as do other citizens.

What the railroad industry asks, and believes it is entitled to, is to offer its services on a fair and equitable competitive basis, with all transportation agencies operating under the same ground rules. That is not the situation today. The railroad industry is one of the most "regulated" industries doing business in this country. Every rate, tariff, safety regulation, and business procedure is under the strictest regulation of either the Interstate Commerce Commission at the federal level or comparable state utility commissions at the state level. They can neither add to nor subtract from their services or vary their tariffs without approval, usually following lengthy hearings, of one or the other, or both, of these regulatory bodies.

What do our competitors face in these matters? While the movement of freight by the interstate motor carriers over the highway is under ICC regulation as to safety questions, only one-third of the intercity traffic moved by truck is subject to other regulations of the ICC. The remaining two-thirds is exempt by law or rules. Cargo that moves by waterway is regulated only to the extent of about 10 percent.

You may ask why the railroads do not enter these other fields of transportation. Here, again, they are regulated to the extent that only under very limited conditions can they offer anything but rail service to their customers.

Within the past 18 months a great deal has been said about the proposed expanded federal-aid highway program. Legislation is now before the Congress that will authorize a 13-year federal-aid highway program estimated to require approximately $37 billion in federal funds, with an additional $14 billion supplied by the state and local governments. This is the largest peacetime authorization of funds ever made by this or any other government in history. On the 40,000-mile interstate system, the present estimated cost is $27 billion and the Federal Government is being asked to put not less than $25 billion of federal funds into this system alone, paying a minimum of 90 percent of the total cost in each state.

Truckers heavily subsidized

There is only one possible source of such revenues and that is from taxation. The railroad industry has not taken any position as to the dollar outlay for the highway program. We have in no way opposed improved highways. We have taken the position that the Federal Government should finance this program from equitable user changes to be levied by the Federal Government on the basis of benefits derived by the user. In other words, the railroads believe that the trucking industry should pay its fair share of the cost of this, or any other, highway program and that an undue proportion of the financing burden should not be placed on the shoulders of the automobile owner or general taxpayer as it is now. In the absence of such equitable federal user charges, the heavy trucker will continue to be subsidized as a major competitor of the railroads. Is this fair, either to us or to the public generally?

The railroads have taken another position, namely, that if the Federal Government is to be called upon for such an enormous financial outlay for road purposes, it should do what every state has found it necessary to do—place a federal ceiling on the sizes and weights of motor vehicles using the highways, in general agreement with the national policy of the American Association of State Highway Officials. Otherwise we will see our heavy investments in highways prematurely destroyed by the ever-increasing loads placed upon them by the heavy truck.

Both of these positions have been opposed by spokesmen for the trucking industry. These same spokemen, on the other hand, have been strong supporters of what they call an "across-the-board" financing program, or a tax program of equal rates for all vehicles regardless of the character or type of vehicle. Such a program leaves the automobile owner "across-the-barrel."

Spoon feeding is justified and necessary for an infant, but when manhood is attained it is neither necessary nor justified. Presumably the attainment of manhood carries with it the responsibility of earning one's way. We believe that the trucking industry has long since attained the status of manhood and should be able to pay its own way, if it is ever going to be able to do so.

(This article was originally presented as a paper at the ASCE Knoxville Convention, before the Highway Division session presided over by N. W. Dougherty, Dean of Engineering, University of Tennessee.)

Southern Florida reaps benefits from

W. TURNER WALLIS, M. ASCE, Executive Director,

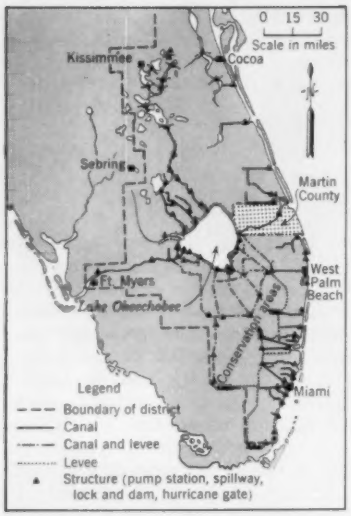


FIG. 1. Central and Southern Florida Flood Control District has prepared comprehensive plan for irrigation and water control in its 15,700-sq mile area, outlined by dashed line. Major works are shown.

Almost universally, irrigation makes a valuable contribution to productive agricultural enterprises, and the increasing attention being given to it in southern Florida is indicative of a number of beneficial effects on farming and ranching in this part of the state. With a controlled water supply, many new areas can be successfully developed, and the yield of lands already under cultivation or in pasture can be markedly increased. In many cases, capabilities of soils can be enlarged, permitting a more productive use of the land. Dry periods, which occur seasonally during the year in this part of the state, frequently linger until serious drought conditions prevail. More intensive development will result from reasonable assurance of a dependable water supply.

Experience in Martin County attests the value of irrigation practices in agricultural activities. In this county—most of it typical of the sandy coastal plain of the Florida peninsula—farmers and ranchers have been successful in effectively using the available water to overcome the natural agricultural limitations of the area. Irrigation has made possible a profitable commercial vegetable industry, and is equally important to the county's citrus production. In recent years, ranching has played an increasingly important role largely because of increased production attributable to irrigated pastures.

Favorably located between Lake Okeechobee and the Atlantic Ocean on the lower east coast of Florida, as shown in Fig. 1, Martin County is characterized by flat, low terrain that slopes generally to the southeast at the rate of about one foot per mile. A topographic contrast is provided by the three sand ridges which parallel the coastline at elevations up to 45 ft above sea level.

Intensive agriculture favored

A fortunate association of natural conditions favors intensive agricultural development. The average annual temperature is 73 deg F, ranging between extremes of 90 and 28 deg F. As a result of the moderating effects of the lake and the ocean, frost is likely to occur less than two days a year. In an average year, 55 in. of rain will fall, but two-thirds of it will come between June and October, leaving the remaining seven months very dry. With proper management, a large part of the 357,760 acres in the county is suited to some kind of agricultural use. Surface soils are mostly fine sands, except for sloughs and marshes and the area around Lake Okeechobee, where organic soils occur.

Without irrigation, some agriculture is possible, but most of the unirrigated lands are in unimproved cattle range. With adequate water control, however, the limited capabilities of the sandy soils are raised, and the seasonal rainfall is of much less consequence. For these reasons, irrigation is desirable, and the availability of water, the flat topography, and soils with suitable subsurface conditions are a favorable combination that has contributed to the current trend toward large-scale irrigation activities. With the advantage of these natural factors and the mild climate, agriculture in Martin County is undergoing notable development—both in area involved and in intensity of use.

In 1940, there were 2,429 acres of irrigated land in the county—almost all in truck crops. A total of 2,514 acres of vegetables produced a crop valued at $172,761, while approximately 30,000 acres of unimproved range supported 1,677 head of cattle. Citrus trees occupied less than 900 acres. By 1954, the vegetable crop grown on 2,738 acres was valued at $967,150. Almost 200,000 acres were used as pasture and range for 20,561 head of cattle. A significant factor in the increased productivity of the land was the 10,135 acres being irrigated at that time.

Today, over 21,000 acres are under irrigation, and the acreage is increasing rapidly. The somewhat scattered location of these irrigated lands may be seen by reference to Fig. 2. In the county, 5,850 acres are in permanent cropland for rotated vegetables and pasture; around 8,000 acres are under temporary cultivation for vegetables; 286,700 acres are used for pasture and range; and 1,600 acres produce citrus fruit.

Both overhead and subsurface irrigation are practiced in Martin County. Sprinkler irrigation is used on a small part of the citrus and vegetable lands, but accounts for only about 2 percent of the total land irrigated, while 98 percent is subirrigated.

Economy of subirrigation

Used elsewhere more generally by vegetable growers, subirrigation has been developed in Martin County with the help of the Soil Conservation Service for use primarily on pastures. If the slope, permeability, and water-retaining ability of the soil are suitable, this system can be used with a great deal of economy and simplicity of management. The usual procedure is to use gravity canals from pumps at the source of water to the high point of the irrigation system. The water is then turned into field supply ditches as needed, and from there it flows into regularly spaced field ditches, or laterals. Horizontal seepage from these ditches raises the water table to within 12 or 15 in. of the ground surface for pasture, at which point it is allowed to recede to

IRRIGATION

Central and Southern Florida Flood Control District, West Palm Beach, Fla.

24 to 30 in. below the surface before more water is turned into the system.

Capillary attraction causes the moisture to rise to the roots of the grass. The details of a typical 80-acre subirrigation for pasture are shown in Fig. 3. For cropland, the system is similar, but the water table is held constant at 24 to 30 in. below the surface, depending on the rooting habits of the plants.

During the summer rainy season, this system of canals and ditches provides the means for controlled surface runoff of excess water. A typical pasture irrigation system will permit the removal of about 4 in. of water in a 24-hour period, while the cropland system will accommodate from 6 to 12 in. in the same period. To be used for this purpose, however, the system must have an outlet available. In an area that experiences both wet and dry seasonal extremes, the duality of purpose served by a subirrigation system has made it popular in Martin County.

Irrigation activities presuppose a dependable source of water obtainable by some feasible means. Wells are used to some extent in Martin County,

St. Lucie Canal, which flows from Lake Okeechobee, provides most of water used for irrigation in Martin County, Florida. Aerial view, looking southwest, shows lock and spillway $7^1/_2$ miles upstream from Stuart, Fla.

Diesel-operated pump with capacity of 25,000 gpm lifts water 15 ft from St. Lucie Canal to irrigation system. Dual pipes behind intake are drainage outlets.

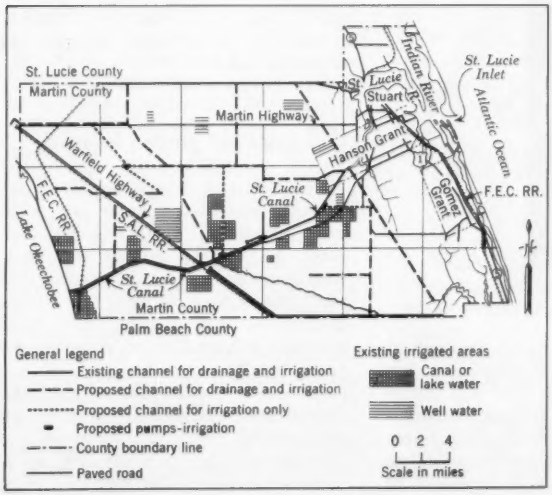


FIG. 2 System of canals to provide drainage and irrigation water to all agricultural areas in Martin County has been prepared by Martin County Flood Control and Water Conservation Committee in cooperation with Soil Conservation Service and Flood Control District. Note location of existing irrigated areas.

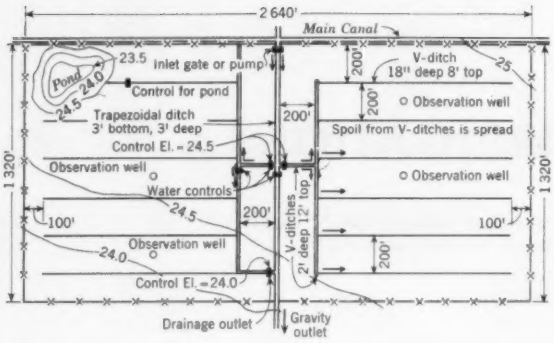
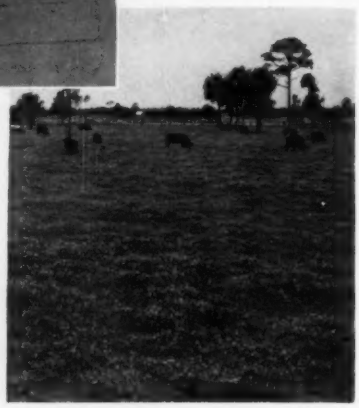


FIG. 3. Typical plan for 80-acre subirrigation system for pasture land shows arrangement of ditches and other features. Water requirements are 560 gpm, and drainage requirement is 1 in. in 24 hours. Observation wells are used to determine water-table level. Typical soil is 3 ft of sand over marl.

Typical subirrigation system for pasture land is seen from air above. Main channel runs from front to back of photo while supply ditches run crosswise. In close-up view at right, note fine growth of pandola and white clover on which cattle are grazing.



Control structures regulate flow from main canal to supply ditches on each side. Individual control of each ditch is provided by flashboards, one of which is being manipulated by operator on far bank.

but because of their limited flow, are inferior to surface sources for irrigation purposes. A fortunate feature in this county is the St. Lucie Canal, which traverses the county from the southwest corner at Lake Okeechobee to the St. Lucie River at the northeast. This waterway, which crosses much of the area suitable for irrigation, was opened in 1926 by the Everglades Drainage District as part of a program to regulate the level of Lake Okeechobee, and has since been enlarged by the U.S. Army Corps of Engineers to increase its serviceability as a water control and navigation facility. Since the control structure of this 30-mile canal is located near its mouth on the eastern end, the water in almost its entire length is maintained at approximately the level of Lake Okeechobee.

The 21,000 acres at present under irrigation receive a total of about 660 acre-ft of water per day during the irrigation season from November to May, and in times of drought, the amount is appreciably more. Various crops have different daily use rates, with citrus and row crops requiring less water than field crops and pasture. Based on the Blaney-Criddle formula, citrus trees consume about 0.09 to 0.15 in. of water a day per acre in Martin County, while grass-legume pasture varies from 0.11 to 0.18 in. per acre per day. The fluctuation depends on the time of year, but for the whole year, approximately 44 in. are needed for citrus and 53 in. for pasture. Since only about 50-percent efficiency can be expected from the irrigation system, the actual water requirements are almost doubled.

Truck crops and grazing featured

Benefits from effective water control through irrigation systems are three fold—increased yields, reduced unit costs, and better use of the land. Irrigation is considered essential for successful truck farming or citrus growing in the county, and these activities will continue to be dependent on artificially supplied water. Except for the area of peat soils around Lake Okeechobee, commercial vegetables are not usually grown repeatedly on the same tracts. On the sandy soils, truck crops are either rotated with two years

of pasture or shifted to entirely new areas. Tomatoes—one of the principal crops of the area—are susceptible to diseases and parasites found in the soil, and are not grown again on the same land.

This fact has resulted in a system of land rental which benefits the landowner. A commercial vegetable grower will rent a tract of virgin sandy land for a two-year period and will install an irrigation system for his use during that time. After he has planted a crop of tomatoes and followed that with a crop of some other vegetable, he will move on to new land. The landowner—generally a rancher—will then reorganize the irrigation system and plant improved grasses and legumes. Through this practice, 5,000 acres of irrigated pastures were developed in the county last year.

Almost four-fifths of the total land area of the county is used to graze cattle, with an average of about 10 acres for each animal. As irrigation is extended to pastures, their supporting capacity is greatly increased. A combination of improved grasses and legumes such as pandola and white clover can produce over 800 lb of beef a year on an acre of irrigated pasture. Without irrigation, the best improved pastures in the county could expect no more than 300 lb, and the quality of the beef would not be as high. Ranchers in Martin County have obtained as high as $2^3/_4$ lb of beef per animal per day over a four-month period by grazing 1,250 head of cattle on 750 acres of irrigated pasture.

Reduced cost of fertilization

Another important feature of irrigation is the reduced cost for fertilization. On unirrigated pasture, 0.068 lb of fertilizer is required on grass pasture and 0.039 lb on grass-legume pasture to produce one pound of beef. Grass-legume combinations are used on all irrigated pasture, but only 0.016 lb of fertilizer is needed for similar results.

Other uses for the irrigation system have been successful. Flooding of fields with a foot of fresh water seems to be an effective control measure for one type of tomato disease or pest. Also, when frosts of short duration occur, the ill effects are lessened by filling the ditches of the irrigation system. Both of these practices require large quantities of water, and would be practical only where water is abundant and cheap.

In view of the benefits derived, the cost of a typical subirrigation system is extremely reasonable. If the farm operator has access to a dependable source of surface water, he can install the system for about $25.00 per acre. Thus, over a theoretical ten-year life of the system, the annual cost amortized at 6 percent is $3.30 per acre. Initial costs include $15.00 per acre for a pump, $5.00 per acre for the main canal, and $5.00 per acre for supply and feeder ditches. In addition, about $1.50 per acre is spent each year for maintenance. If wells have to be used for lack of a surface water supply, the costs vary with the number of wells required.

Because of the availability of suitable land tributary to the St. Lucie Canal, many commercial vegetable farmers have been moving their operations into Martin County. Most of the water used for this purpose is drawn from the St. Lucie Canal, and the landowners along its course have been among the first to utilize irrigation methods. For the most part, development so far has been of a random nature, with individual initiative and fortuitous location as prime factors. The influence of the St. Lucie Canal on the location of irrigated lands is suggested by the development pattern seen in Fig. 2.

Coordinated plan developed

As this random development continued, it became evident that a coordinated plan was needed to serve as a guide for the establishment of irrigation facilities in the county. Consideration was given to the basic requirements for water control in Martin County in the comprehensive plan of the Central and Southern Florida Flood Control District, and the storage of water and the use of drainage canals for irrigational purposes were included in this multipurpose project. The comprehensive plan for the entire 15,700-sq mile Flood Control District is shown in Fig. 1.

In 1953, a secondary complementary plan was prepared by the Martin County Flood Control and Water Conservation Committee, with technical assistance from the Martin County Soil Conservation District, the Soil Conservation Service, and the Flood Control District. This plan, shown in Fig. 2, envisions a system of canals to provide drainage and irrigation water to all of the agricultural area of the county. Five pump stations are planned to lift water from the St. Lucie Canal into gravity canals, which will put water from Lake Okeechobee within reach of almost all landowners. Consideration given to the possibility of assisting in the control of water in St. Lucie County on the north and Palm Beach County on the south gives this plan a tri-county aspect.

Since the Flood Control District does not include the construction of these secondary works within the scope of its activities, the execution of this complementary plan will be the responsibility of the people of Martin County. Adherence to this plan by both individual and cooperative efforts ultimately will result in an effective water control system for the whole county.

Based on land capabilities and recommended land uses determined by the Soil Conservation Service, the ultimate development of Martin County could put as many as 125,000 acres under irrigation. The demand for water for this purpose may be as high as 580,000 acre-ft per year. Lake Okeechobee via the St. Lucie Canal is foreseen as the largest source of supply. Adequate water control will make new land available for citrus and truck crops, and will considerably improve the pastures used for beef cattle, but because of sensitive markets and other fluctuating economic factors, the increase in acreage for these uses cannot be accurately predicted. However, based on the highest potential use, the county ultimately could have 13,500 acres in cropland, 12,000 acres in temporary vegetable area, 100,000 acres in irrigated pasture, and 200,000 acres in unirrigated pasture.

Progress to date has been the result of the initiative and cooperation of local interests. Through the combined efforts of the farmers and the technical agencies, irrigation has provided the means for successful use of otherwise unproductive soils. But it must be kept in mind that irrigation cannot effect a cure for all the agricultural ills of an area such as Martin County. In fact, irrigation, if practiced unwisely, may actually be harmful to the land or the natural water supply, or both. There must be a need for irrigation, and many natural and legal factors must be considered before the practice can be effectively put to use. Indiscriminate drainage and haphazard irrigation activities must be avoided in the interest of conservation of natural resources. Only through cooperative planning toward a well designed, integrated system can irrigation provide the greatest benefit to the people of Martin County.

The author gratefully acknowledges the valuable assistance of the individuals and agencies who contributed to the preparation of this article. Special gratitude is due to the U.S. Soil Conservation Service, and particularly to Howard Nelson, Area Engineer, Stuart, Fla.

(This article was originally presented by Mr. Wallis as a paper at the ASCE Knoxville Convention, before a session of the Irrigation and Drainage Division presided over by H. T. Critchlow, a member of the Division's Executive Committee.)

G. W. REYNOLDS

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KRAFT PAPER PLANTS—

During the past five years, the paper demand in the United States has increased from 360 lb per person annually, to over 410 lb. New uses are continually being developed for paper and paperboard, especially in the wrapping and container industry.

Pulp for paper is produced by one of two methods: mechanical pulping by grinding wood with pulp stones in conventional grinders; and chemical pulping by cooking wood chips in a solution under pressure. Chemical pulping can be done by three different methods, each using similar equipment, but different cooking solutions, as follows: the sulphite process, using a sodium bisulphite liquor for cooking; or the soda process, using a sodium hydroxide solution for cooking; or the sulphate or kraft process, using sodium hydroxide and sodium sulphide for cooking.

Each of these processes has its advantages for the kind of wood being pulped and for the type of paper to be manufactured. It is interesting to note that ten years after the end of World War II, production capacity in the United States wood-pulp industry had increased by more than 10 million tons annually—from 19 million to over 29½ million tons. Of this increase, 60 percent was in the kraft industry, 20 percent in the new high-yield pulping process, about 10 percent in the ground wood industry, and about 10 percent in the dissolving and other chemical pulps.

In view of the tremendous expansion of the kraft industry during the past ten years, and the importance of the southeastern section of the country as the greatest potential source of pulp wood, it is fitting that this article should deal with the design and operation of a typical kraft mill and its features of special interest to the civil engineer.

"Kraft" to Swedish-speaking people means "strong." To Americans, it has come to mean high-strength brown paper made by our southern paper mills by the "sulphate" process. This process is essentially a procedure for separating the cellulose fiber from the other materials present in the wood. It was first proposed in Europe in 1879 and was slow developing in this country. Its recent growth here has been speeded greatly by the development of modern chemical recovery equipment that has made the process commercially economical. One of its chief advantages is that it is best adapted for pulping the resinous Southern pines, producing a strong fiber valuable for the manufacture of wrapping papers, multi-wall bag, and linerboard for corrugated shipping containers.

The layout of a recently built kraft mill is shown in Fig. 1. Its principal features are:

1. Wood yard, where the pulp wood is unloaded, barked, prepared for the next operation, or temporarily stored.
2. Pulp mill, where cellulose fiber is produced from the wood chips.
3. Paper manufacturing building, where the fiber is refined and the sheet of paper formed. The supporting phases of the operation include the power plant; the water treatment plant; the caustic plant, where the cooking liquor is prepared; and the chemical recovery plant, where the spent liquor is processed.

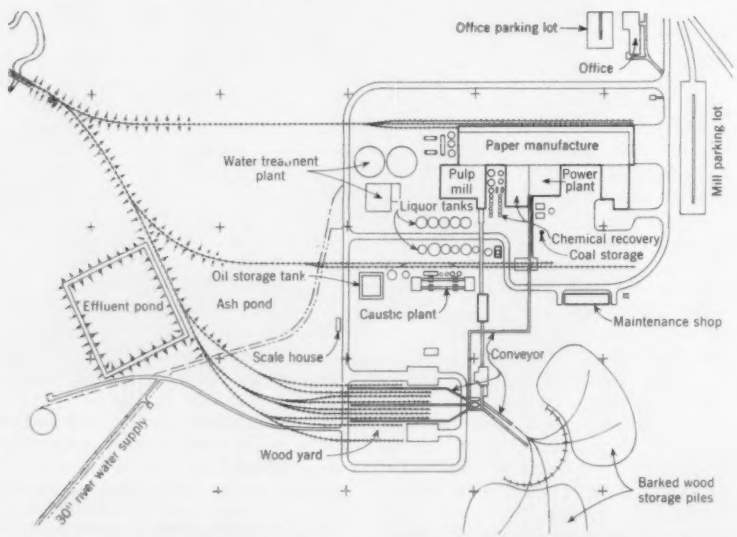


FIG. 1. Layout of recently built kraft mill shows principal phases of operation. Cleared area required is about 90 acres, of which 7 acres are under roof.

Wood preparation

Pulp wood is delivered to the mill from its point of origin or production usually by a combination of two or more methods—water, rail and road. Water shipment is usually the cheapest and is therefore generally preferred when feasible.

Before it is unloaded, the wood is scaled or measured to determine the volume content for payment. Some mills weigh their incoming wood for payment. In the southeastern section of this country, the measurement is usually expressed as a "unit" which consists of stacked wood 5 ft 3 in. long, piled 8 ft long and 4 ft high—the equivalent of 1⅛ U.S. standard cords.

Wood-yard layout and design present several unique problems to the engineer.

basic design
construction
operation

The layout should provide for: (1) unloading, barking and cutting of wood for the mill's daily average demand for chips; (2) unloading, barking and sending to storage of peak loads during seasonal periods of high delivery; (3) adequate storage to supply the mill's demand during off-season production of pulp wood; and (4) reclaiming about one-third of the mill's demand from storage during the off-season period.

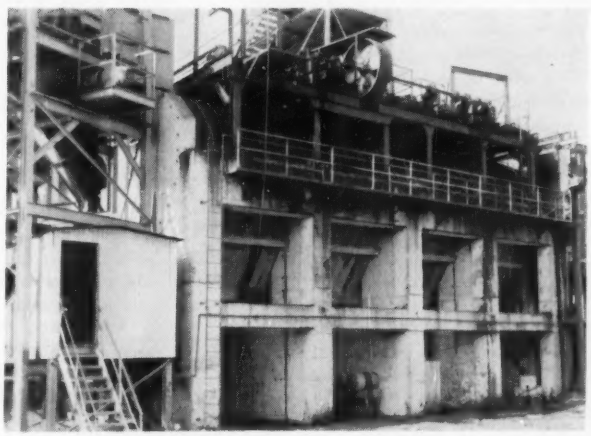
Let us assume a mill producing 650 tons of paper per day and using 1.4 units of wood per ton of paper. Equipment to handle over 900 units per day would be required for Operation No. 1 above, and additional equipment to handle about 400 units for Operation No. 2. Equipment to reclaim, Operation No. 4, would be required to handle about 300 units. Storage capacity, Operation No. 3, is based on empirical estimates depending largely on seasonal production. A 20- to 30-day supply is considered a safe amount for storage.

The wood in unloaded and conveyed to the barking drum usually by single-strand chain and steel-decked conveyors. During the past several years, however, water flumes built of concrete and lined with steel have successfully handled this unloading job. Rubber belt conveyors in recent years have also been successfully used. For our typical plant, unloading space for 25 to 30 rail cars should be provided to reduce switching of cars to about three times a day. This will require unloading conveyors of a total equivalent length of 900 ft, and can be accomplished by installing several conveyors with a maximum length of 300 to 350 ft.

The next step is to remove the bark from the logs. This is done in a rotating drum where the tumbling action removes the bark by friction. The bark is normally not used in paper making and is therefore sent to the power plant for fuel. After barking, the clean logs are sent either to the chipper for mill production or to storage.

Pulpwood log stackers can economically store wood 70 ft high. Stored wood

In a pulpwood unloading area, both rail and truck shipments are handled by same chain conveyor. In left foreground 50-ft tower with 35-ft boom unloads wood from truck with cable slings.



Barking drum consists of steel cage 12 ft in diameter and 45 ft long, chain-suspended 25 ft above ground. Drum is driven at 6 rpm and weighs 90 tons fully loaded.

Pulpwood stacker can store barked wood in pile 70 ft high, thus conserving space and reducing capital investment for log reclaiming equipment. Stacker travels on 170-deg arc with total boom length of 318 ft, of which 130 ft is cantilevered.

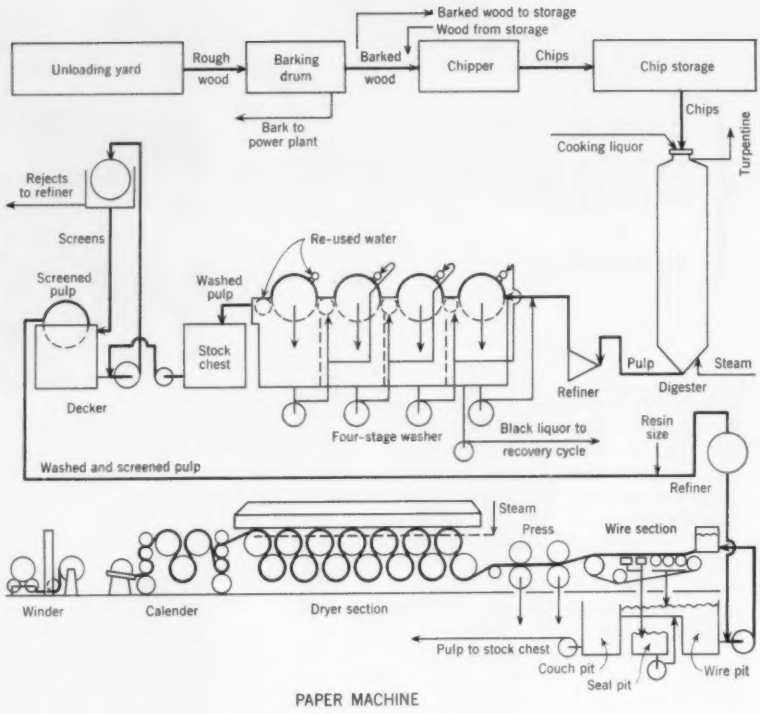


FIG. 2. Flow diagram of typical kraft pulp and paper mill shows main processes.

is best reclaimed from storage by a water flume running under the pile at ground level, about 36 in. wide and 5 ft deep. Such flumes are generally of reinforced concrete, steel lined at log loading areas. This type of flume usually has a $1^1/_2$-in. slope per 100 ft of length to overcome friction. A suitable water velocity of 5 to 7 fps will normally reclaim 30 units per hour and require a flow of 12,000 gpm.

Chips are cut from the clean logs with multi-knife chippers, consisting usually of 10 or 12 knives mounted on a heavy disk of 90-in. diameter, driven at the relatively slow speed of 400 rpm. These machines have an unbelievable capacity for cutting logs up to 19 in. in diameter by 6 ft long into chips of $^1/_2$ to $^5/_8$-in. thickness in $1^1/_2$ seconds. The chips are usually discharged beneath the chipper on a belt or drag-type conveyor. This requires special consideration for the chipper foundation, to allow space for a wide apron or belt conveyor to receive chips and to provide a rigid foundation for the machine with its steady impact loading.

For flexibility of operation between the wood yard and the pulp mill, chip storage capacity should be equivalent to 8 to 12 hours of operation of the pulp mill. The plant here being described has a rectangular steel bin with both sides sloping at 45 deg. The chips are fed to the top of the bin and distributed by an automatic reversing belt tripper. To feed chips from the bin, three traveling tapered helical conveyors undercut the chips and load them onto a belt conveyor. The most important feature of the chip bin design is adequate slope of sides and bottom to assure a free flow of chips without arching and fouling.

Manufacture of pulp

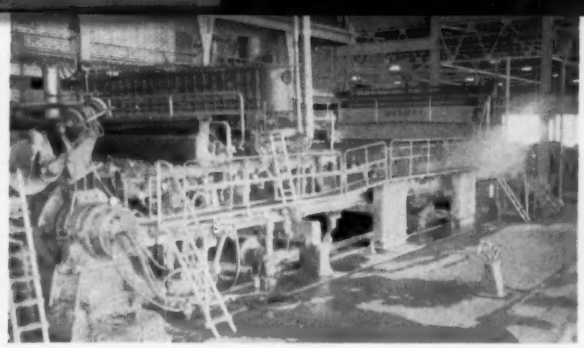
It is in the digester or cooking operation that the cellulose for paper making is separated from the lignin, resin, and other materials in the wood. Most wood for pulp making contains about 50 percent moisture by weight, 25 percent cellulose, and 25 percent other organic material. The digester is usually a stationary vessel, measuring about 12 to $12^1/_2$ ft in diameter by about 40 to 45 ft long. It is set vertically and mounted on a structural steel frame near its base, but normally not tied to the building steel, so as to allow for some free movement of the vessel when steaming.

The charged digester is now ready for steaming, which usually requires $1^1/_4$ hours to bring it to a cooking pressure of about 105 psi and then one hour for cooking. During the cooking operation, the digester is vented to release non-condensibles and turpentine vapor. At the completion of the cook, the individual fibers are free in a suspension of black liquor, called pulp. A remote controlled valve at the base of the digester is opened and the pulp is blown under pressure to a receiving tank where flash vapor and heat are recovered by a cascade-type condenser. The hot water is temporarily stored in an accumulator for re-use in the washing and liquor-making operation.

The pulp is now ready for washing and screening, which separates the black liquor containing the spent chemicals and organic material from the fiber and also separates any uncooked chips from the accepted fiber. Washing is accomplished with vacuum filters using three or four sets in series. See Fig. 2.

Each filter is a revolving drum usually $11^1/_2$ ft in diameter by 16 ft long, covered with a fine stainless-steel wire cloth. The inside of the drum filter is under a vacuum and pulls liquor through the wire cloth, leaving the pulp on the wire face to be washed. Pulp is washed on the first-stage filter with filtrate from the second stage. The pulp leaving the first stage is then diluted with filtrate from the second stage and fed on the second-stage filter, where it is washed with filtrate from the third stage. Pulp leaving the second stage is then diluted with third-stage liquor, washed on the third-stage washer with fourth-stage filtrate, and passed to the fourth-stage filter and given a final wash with fresh hot water. This system, known as counter-current washing, is designed to make the smallest amount of water perform the greatest amount of washing with a minimum of liquor dilution.

It is important that the pulp stock be washed clean and that most of the spent chemicals be reclaimed. It is also important that the minimum amount of water be used for washing as all extra water added to the spent liquor will have to be evaporated to recover the chemicals. In recent years, the valveless type of filter for washing has been introduced, which possesses certain advantages over the older style of vacuum filter. The valveless filter, which develops a maximum vacuum of about 8 in. of water within the channel wall construction, lends itself to a less expensive building, as it can be mounted directly on top of its filtrate tanks about 23 ft above the ground level. The vacuum-type filter, on the other hand, requires a barometric down leg, which necessitates setting at an elevation approximately 40 ft above the ground level.



Forming section of paper machine (above left) has head box at rear, where fiber is fed to the wire. Table rolls and suction boxes are in center and couch roll at left. View at right above shows other end of paper machine, with finished roll ready for transfer. Calender section is to right of roll, and dryers are in background.

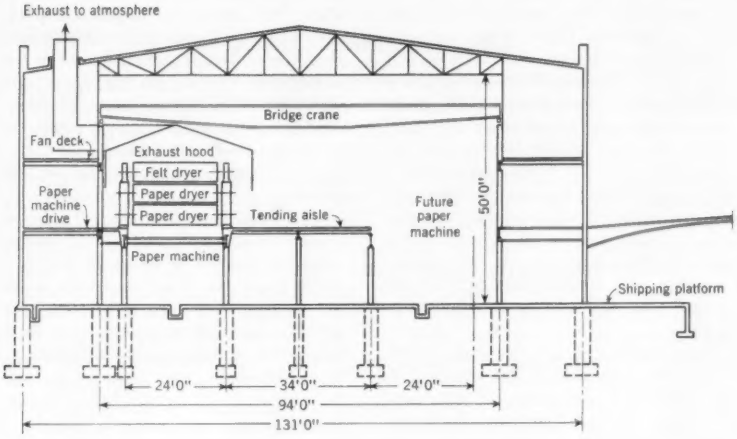
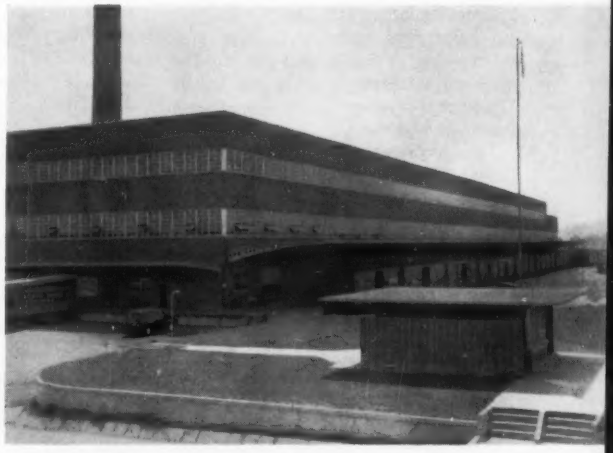


FIG. 3. Cross section shows arrangement of paper machine building with one machine installed and space allowed for second machine at right. Paper machine is longest piece of equipment in plant (441 ft) and usually represents largest single investment in machinery and housing structure.

After leaving the filter, the pulp is stored in a tile-lined chest at about 4 percent fiber content by weight and then pumped to a dilution and mixing pump where the consistency is lowered to about $1^1/_4$ percent. Next it is fed to a series of centrifugal-type screens which remove the uncooked chips and fiber bundles and send them back for recooking or defiberizing with a refiner. The accepted pulp is given a final wash over a single-stage filter and dropped into a tile-lined chest ready for the next step.



Paper machine building is steel and brick structure 594 ft long and 131 ft wide. Note that rail and truck shipping platforms are protected by overhead canopies.

Paper making

Washed pulp stock requires refining, which makes the individual fibers more pliable and frays out their ends so that they will interlace better, on the wire cloth of the paper machine. Refining is accomplished by the mechanical action of passing the fibers through a close-set pair of stationary and rotating knife bars. This single operation is probably the greatest consumer of electrical power in most kraft mills, requiring about 150 kwhr per ton of paper.

The basic principle of paper making has remained unchanged over the past fifty years. The sheet is formed on the wire cloth, where water is removed by natural drainage and vacuum boxes through the wire. The suction couch roll and press rolls remove still more water, and steam drying of the wet sheet finishes the process.

Briefly, the refined stock is diluted to a mixture of 0.5 percent fiber by weight and fed onto a traveling endless wire cloth at the same speed as the wire. The sheet is formed as the water drains through the wire, interlocking the fibers to form a uniform web across the wire cloth.

The suction press rolls, which come next, remove additional water by the combined action of pressure and vacuum. The nip pressure varies between 250 and 300 lb per lin in. of roll face, and the vacuum varies from 12 to 20 in. of mercury.

TABLE I. Steam and power requirements for normal kraft-mill pulping, per ton of paper

Items	Steam, lb per ton		Power, kwhr, per ton
	50 lb	150 lb	
Wood yard	...	...	24.43
Digester	...	3,643	31.31
Washing & screening	...	...	63.55
Refining	...	...	157.87
Paper	1,905	8,864	90.92
Caustic	...	446	49.00
Evap. & recovery	2,330	1,660	...
Power plant	...	137	95.01
Water supply	...	...	43.91
Total	4,235	14,750	556.00

Next come the steam heated dryers, heated to 300 to 340 deg F, and driven at the same speed as the traveling sheet. They evaporate additional moisture. After the last dryer, the sheet is calendered under pressure with steel rolls to give the desired finish and then wound on a reel for transfer to the finished room.

For every ton of paper produced, approximately 45,000 gal of reused water is required for laying the fibers on the wire. The total water removed by natural drainage, vacuum box and vacuum couch-roll drainage amounts to 97.5 percent of the total removed; 1.3 percent is removed at the press section by applying pressure to the sheet over a vacuum area; and finally 1.2 percent is removed by evaporation in the dryer section.

In addition to fiber and water for paper manufacturing, the following services are required for the paper machine, per ton of finished paper:

86,000 cu ft of air displacement for vacuum at 10 and 20 in. of mercury; 8,800 lb of steam at 150 psi for drying; 90 lb of steam at 50 psi for air heating and ventilating; 2,350,000 cu ft of air for removal of water vapor from the drying section; 1,620,000 cu ft of air heated to a temperature of 115 deg F for makeup purposes; 3,800 gal of treated water for process and makeup; 65 hp-hr for the paper-machine drive; and 75 hp-hr for auxiliary equipment power (pumps, fans and paper machine helper motor drives).

Also several complete instrument systems are required—for paper drying control and efficient removal of condensate from the dryer section, for measurement and weight control of the fiber stock to the machine, for drainage control at the vacuum boxes, and for the press section nip-pressure control.

In the 441-ft total length of the paper machine, the dryer section occupies the longest section, about 290 ft; the wire section requires 76 ft; the press section, 35 ft; and the calenders and reel, 40 ft. An additional length of 30 ft is required for winder operation and another 30 ft for the roll-handling equipment following the winder. In addition, 75 ft of storage space for 100 tons of paper between the reel and the winder was provided to prevent a shutdown of the paper machine in the event of failure of the roll-handling equipment or the winder.

The paper machine is thus the longest piece of equipment in the plant, and usually represents the greatest single investment in machinery and structure. In the plant here described this machine is housed in a steel and brick building 594 ft long and 131 ft wide (Fig. 3). The machine itself is only 15 ft high but was set 17 ft above the floor to allow space under the wire section for pulp-stock chests and reused water chest and other auxiliary equipment at the wet end. Also, to catch the large volume of water vapor evaporated from the dryer section, it was necessary to provide a deep overhanging hood which extends $9^1/_2$ ft above the top dryer. Another $8^1/_2$ ft was provided for the bridge crane used for maintenance purposes.

The entire paper machine frame, from the wire section to the reel, is mounted on a continuous sill consisting of a heavy 36-in. I-beam haunched with concrete on both sides and with a $2^1/_2$-in.-thick cast-iron bedplate grouted in the concrete at the top. This unusual type of structural foundation was provided because this heavy precision machinery requires the most rigid of settings. The two sills were spaced on 24-ft centers and set 17 ft above their foundation, with only a minimum of lateral support between the sills because of the necessity for keeping the space under the dryers open for ejecting waste paper.

The equipment for handling the finished rolls of paper consists of mechanical conveyors, platform scales, and elevator equipment to lower the rolls to the ground level. It was designed to handle paper rolls up to 72 in. in diameter and weighing up to 5 tons. The paper is either temporarily stored at the ground level or loaded into rail cars or trucks for shipment.

Liquor and recovery cycle

The spent chemicals washed from the pulp are reclaimed for making cooking liquor. The recovery cycle includes the following:

1. Removal of water from the black liquor in steam-heated evaporators, usually six in series.
2. Separation of organic and inorganic chemicals by spraying into hot furnace where organic material supports combustion and produces steam in boiler above.
3. Addition of salt cake makeup to the recovery furnace, producing sodium carbonate or green liquor.
4. Causticizing of green liquor with quick lime.
5. Separation of sodium hydroxide and sodium sulphide from lime sludge in clarifiers.
6. Recovery of lime by burning lime mud in a kiln.

Generally speaking, where liquor-recovery equipment is installed, 35 to 40 percent of the steam requirements for the mill are supplied by the fuel content of the organic matter in the spent liquor. The raw material for this operation is sodium sulphate or salt cake. In the southeastern section of this country, about one-third of this material is obtained from Saskatchewan, Canada, where it is mined in its natural state. The other two-thirds is usually obtained from the domestic market from the by-products of chrome plating, rayon and synthetic rubber manufacturing. Modern pulp mills require from 120 to 140 lb of salt cake makeup per ton of paper, depending largely on washer efficiency.

The lime mud from the clarifier is thickened and fed to a kiln as sludge, where it is calcined to quick lime and made ready to slake with the green liquor again. In modern pulp mill practice, approximately 20 lb of fresh lime is required for makeup purposes per ton of paper.

Steam plant

The amount of steam and power required for kraft paper manufacturing largely depends on the pulping process. That is, high-yield pulping, which obtains the greatest amount of fiber from a given amount of wood, requires less steam and substantially more power for mechanical refining, whereas normal-yield pulping requires more steam for cooking and less power for refining. The approximate steam and power requirements for kraft mill operation with normal pulping are given in Table I.

The black-liquor recovery system, as previously stated, generally produces 35 to 40 percent of the steam requirements. This percentage would generally be reduced when producing high-yield pulp as a result of the lower fuel content of the black liquor. The bark obtained from the wood normally produces 15 to 20 percent of the steam requirements. The remaining 40 to 45 percent of the steam is generated with other fuels, usually natural gas or coal. Approximately 0.4 to 0.5 ton of high-grade coal is required per ton of paper for steam and power generation when supplemented with modern recovery and bark-boiler operations. The requirements of steam for cooking and drying purposes have made the extraction and back-pressure turbine economical for obtaining large quantities of process steam and for the generation of power.

(*Continued on page 96*)

Direct design of hingeless arches of constant section

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In a previous article ("Direct Design of Two-Hinged Arches of Constant Section," CIVIL ENGINEERING for January 1956), the writer presented influence values for horizontal reaction, considering both vertical and horizontal loading, for two-hinged arches of constant section. A numerical example was included to illustrate the use of the influence values in the design of a two-hinged arch.

Hingeless arches are statically indeterminate in the third degree. Thus, if the moment, horizontal reaction, and vertical reaction are determined at one support, the moment and forces at any other section can be obtained by computations involving statics only. In this article, influence values for reactions and moment at the right springing are presented for use in the direct design of hingeless arches of constant section. Values are given for vertical and horizontal loading on circular, parabolic, and semi-elliptic arches. A numerical example is included.

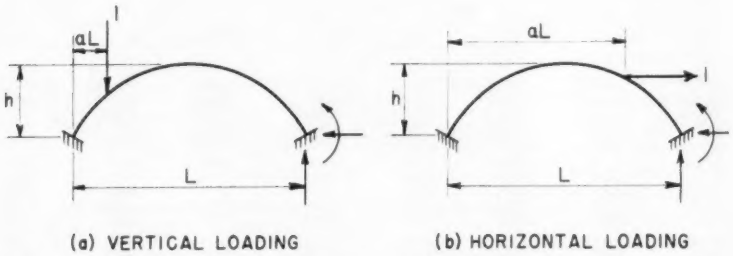


FIG. 1. Identification sketches, showing positive sense of load, and of moment and reactions at right springing.

For the two-hinged arches previously treated, general expressions for influence values were derived by considering the vertical and horizontal displacements of the arch rib when it was moved a unit horizontal distance at a support. For the hingeless arches now under consideration, general expressions were written for the various terms of the column analogy equation, both for a unit vertical load and a unit horizontal load applied on an arch of constant section of each shape considered. The expressions were integrated and evaluated by the writer, Robinson, and Al-Ali. (See "Influence Lines for the Design of Hingeless Arches," by Rhees R. Robinson, a thesis submitted to the Graduate Faculty, Iowa State College, Ames, Iowa, in 1951, in partial fulfillment of requirements for Master of Science degree; and "Influence Lines for Hingeless Arches Under Horizontal Loading," by Ahmed Salman Al-Ali, a thesis submitted to the Graduate Faculty, Iowa State College, Ames, Iowa, in 1954, in partial fulfillment of requirements for Master of Science degree.)

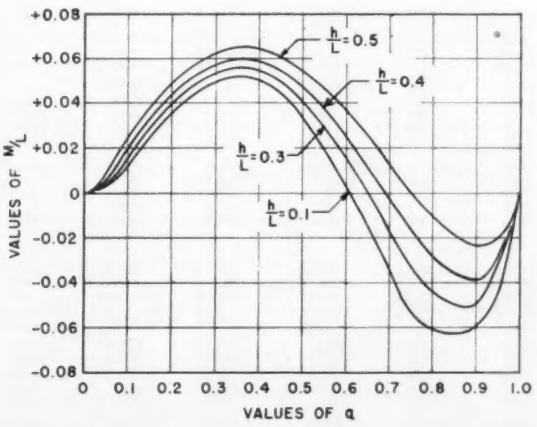


FIG. 2. Influence lines for moment at right springing in circular arches of constant section—vertical loading.

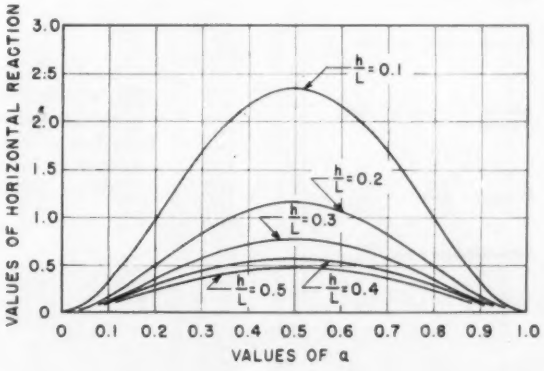


FIG. 3. Influence lines for horizontal reaction in circular arches of constant section—vertical loading.

Values for horizontal reaction, moment at the right springing, and vertical reaction at the right springing resulting from a unit vertical load are given in Table I. Values resulting from a unit horizontal load are given in Table II. For positive sense of the load, and for positive sense of the moment and reactions at the right springing, see Fig. 1. If a load is in the opposite direction to that shown in Fig. 1, the sign of a value taken from Table I or Table II should be changed. If a load is neither vertical nor horizontal, it must be resolved into its vertical and horizontal components before the tables can be used.

Influence values for vertical and horizontal reactions, for load at any one-tenth point on the span, can be read directly in Tables I and II. Influence values for moment are obtained by multiplying values in Tables I and II by the span of the arch.

In Figs. 2 to 7, influence lines for moment, horizontal reaction, and vertical reaction at the right springing of a hingeless, circular arch of constant section were drawn using the values in Tables I and II. Influence lines for use with vertical loading are shown in Figs. 2, 3, and 4, and those for use with horizontal loading are shown in Figs. 5, 6, and 7. Curves similar to those in Figs. 2 to 7 can be drawn for parabolic and semi-elliptic arches through use of the values in Tables I and II.

A sketch of the framing of a hingeless, circular arch of constant section is shown in Fig. 8(*a*). This roof framing is identical to that used in the University of Wyoming Field House except that the ends of that arch are hinged. The purlin loads shown in Fig. 8(*b*), are the same wind loads used in the writer's previously mentioned article ("Direct Design of Two-Hinged Arches of Constant Section") to illustrate the procedure of direct solution for the same arch but with hinged ends. The reactions and moment at the right springing of the hingeless arch, for the loading in Fig. 8(*b*), are determined in Table III.

Influence values for moment and vertical reaction due to vertical loading were obtained by direct interpolation from the curves in Figs. 2 and 4 respectively, and entered in Table III under the columns labeled "M/kip (vert. comp.)" and "V/kip (vert. comp.)" respectively. These values were then multiplied by the appropriate vertical components of load to obtain the values tabulated under the columns labeled "M for vert. comp." and "V for vert. comp." respectively. However, since the values for moment in Fig. 2 are in terms of the span L, they were multiplied by 221 before being entered in Table III. Direct interpolation, in Fig. 3, for values of horizontal reaction due to vertical loading is not as satisfactory. Consequently, values from Fig. 3 were used to plot the curves drawn in Fig. 9. The horizontal reactions (with h/L equal to 0.177) due to unit vertical load applied successively at each purlin point were then read directly in Fig. 9. All such values were entered in Table III under the column "H/kip (vert. comp.)." They were multiplied by the appropriate vertical components of load to obtain the values tabulated under the column labeled "H for vert. comp."

For horizontal loading, influence values for horizontal reaction were interpolated directly from the curves in

TABLE I. Influence values—vertical loading

Influence Values for	h/L	Position of Load 0.1L	0.2L	0.3L	0.4L	0.5L	0.6L	0.7L	0.8L	0.9L
Parabolic arch:										
Moment at right springing	0.1	.0112L	.0317L	.0464L	.0471L	.0307L	.0002L	−.0360L	−.0629L	−.0602L
	0.2	.0112L	.0310L	.0449L	.0448L	.0290L	.0001L	−.0340L	−.0606L	−.0589L
	0.3	.0113L	.0305L	.0432L	.0427L	.0276L	.0004L	−.0320L	−.0580L	−.0576L
	0.4	.0113L	.0300L	.0423L	.0408L	.0261L	.0005L	−.0303L	−.0561L	−.0566L
	0.5	.0113L	.0298L	.0408L	.0393L	.0249L	.0005L	−.0293L	−.0546L	−.0559L
Vertical reaction at right springing	0.1	.0285	.1053	.2175	.3530	.5000	.6470	.7825	.8947	.9715
	0.2	.0297	.1083	.2210	.3553	.5000	.6447	.7790	.8917	.9703
	0.3	.0310	.1113	.2246	.3576	.5000	.6424	.7754	.8887	.9690
	0.4	.0319	.1137	.2273	.3596	.5000	.6404	.7727	.8863	.9681
	0.5	.0326	.1155	.2297	.3612	.5000	.6388	.7703	.8845	.9674
Horizontal reaction	0.1	.3075	.9665	1.6546	2.1554	2.3354	2.1554	1.6546	.9665	.3075
	0.2	.1591	.4888	.8282	1.0682	1.1546	1.0682	.8282	.4888	.1591
	0.3	.1098	.3323	.5531	.7067	.7610	.7067	.5531	.3323	.1098
	0.4	.0849	.2528	.4173	.5255	.5638	.5255	.4173	.2528	.0849
	0.5	.0695	.2049	.3327	.4171	.4460	.4171	.3327	.2049	.0695
Circular arch:										
Moment at right springing	0.1	.0121L	.0341L	.0491L	.0503L	.0341L	.0032L	−.0331L	−.0604L	−.0592L
	0.2	.0131L	.0351L	.0500L	.0507L	.0354L	.0069L	−.0272L	−.0548L	−.0561L
	0.3	.0155L	.0386L	.0532L	.0554L	.0404L	.0165L	−.0162L	−.0435L	−.0496L
	0.4	.0197L	.0431L	.0571L	.0585L	.0471L	.0254L	−.0021L	−.0281L	−.0394L
	0.5	.0241L	.0479L	.0617L	.0639L	.0553L	.0375L	+.0139L	−.0097L	−.0237L
Vertical reaction at right springing	0.1	.0286	.1053	.2176	.3529	.5000	.6471	.7824	.8947	.9714
	0.2	.0307	.1100	.2226	.3562	.5000	.6438	.7774	.8900	.9693
	0.3	.0348	.1178	.2305	.3610	.5000	.6390	.7695	.8822	.9652
	0.4	.0416	.1287	.2406	.3669	.5000	.6331	.7594	.8713	.9584
	0.5	.0510	.1423	.2522	.3735	.5000	.6265	.7478	.8577	.9490
Horizontal reaction	0.1	.3193	.9944	1.6817	2.1850	2.3678	2.1850	1.6817	.9944	.3193
	0.2	.1706	.5099	.8466	1.0826	1.1668	1.0826	.8466	.5099	.1706
	0.3	.1305	.3628	.5778	.7304	.7742	.7304	.5778	.3628	.1305
	0.4	.1178	.2935	.4443	.5432	.5774	.5432	.4443	.2935	.1178
	0.5	.1150	.2523	.3638	.4348	.4591	.4348	.3638	.2523	.1150
Semi-elliptical arch:										
Moment at right springing	0.1	.0273L	.0647L	.0916L	.1001L	.0872L	.0567L	.0157L	−.0222L	−.0386L
	0.2	.0264L	.0575L	.0780L	.0829L	.0736L	.0461L	.0130L	−.0179L	−.0322L
	0.3	.0253L	.0528L	.0716L	.0736L	.0632L	.0414L	.0145L	−.0143L	−.0281L
	0.4	.0246L	.0499L	.0651L	.0679L	.0585L	.0390L	.0135L	−.0115L	−.0254L
	0.5	.0241L	.0479L	.0617L	.0639L	.0553L	.0375L	.0139L	−.0097L	−.0237L
Vertical reaction at right springing	0.1	.0339	.1129	.2241	.3566	.5000	.6434	.7759	.8871	.9661
	0.2	.0413	.1244	.2349	.3631	.5000	.6369	.7651	.8756	.9587
	0.3	.0464	.1327	.2428	.3678	.5000	.6322	.7572	.8673	.9536
	0.4	.0498	.1384	.2484	.3711	.5000	.6289	.7516	.8616	.9502
	0.5	.0510	.1423	.2522	.3735	.5000	.6265	.7478	.8577	.9490
Horizontal reaction	0.1	.4977	1.2916	2.0320	2.5450	2.7236	2.5450	2.0320	1.2916	.4977
	0.2	.2654	.6364	.9662	1.1877	1.2807	1.1877	.9662	.6364	.2654
	0.3	.1835	.4219	.6336	.7606	.8072	.7606	.6336	.4219	.1835
	0.4	.1413	.3158	.4612	.5552	.5876	.5552	.4612	.3158	.1413
	0.5	.1150	.2523	.3638	.4348	.4591	.4348	.3638	.2523	.1150

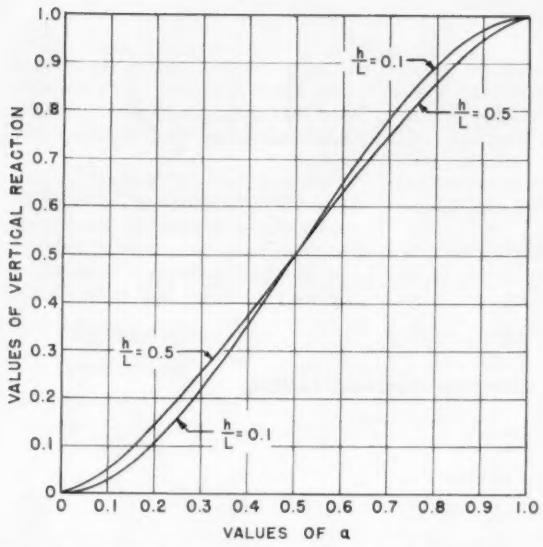


FIG. 4. Influence lines for vertical reaction at right springing in circular arches of constant section—vertical loading.

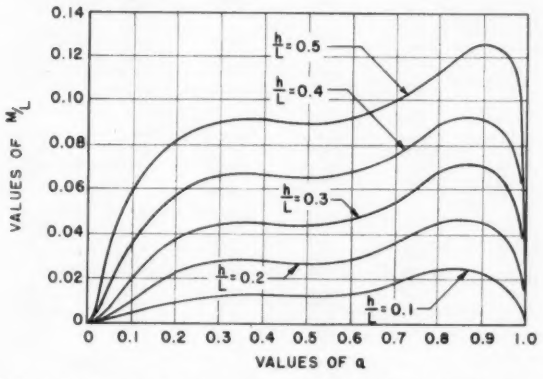


FIG. 5. Influence lines for moment at right springing in circular arches of constant section—horizontal loading.

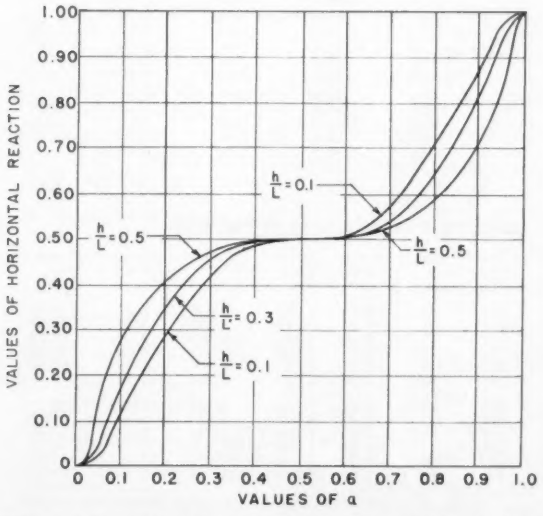


FIG. 6. Influence lines for horizontal reaction at right springing in circular arches of constant section—horizontal loading.

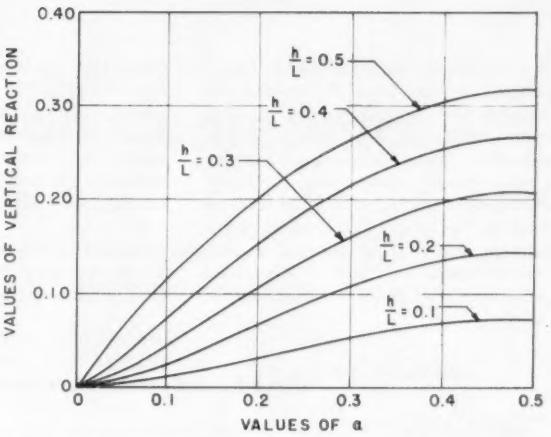


FIG. 7. Influence lines for vertical reaction at right springing in circular arches of constant section—horizontal loading.

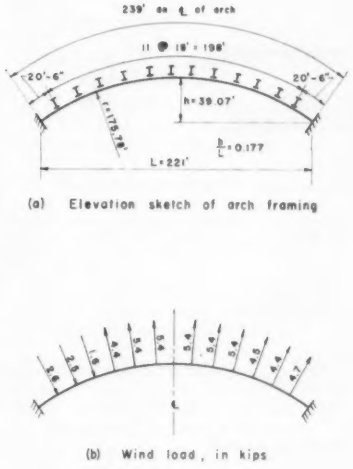


FIG. 8. Arch dimensions and loads for a hingeless circular arch of constant section. This roof framing is identical to that in University of Wyoming Field House except that the ends of that arch are hinged. Reactions and moment at right springing of hingeless arch are determined in Table III.

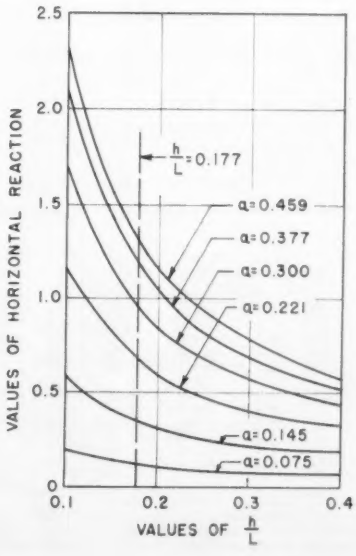


FIG. 9. Influence ordinates for horizontal reaction in circular arches of constant section—vertical loading.

Fig. 6. Fairly accurate direct interpolation, in Figs. 5 and 7, for values of moment and vertical reaction due to horizontal loading is possible, but it is somewhat more satisfactory to plot curves similar to those in Fig. 9. From the curves resulting from cross plots of those in Figs. 5 and 7, the values of the moment and vertical reaction due to unit horizontal load applied at a purlin point were read directly and entered in Table III. Here too, since the values for moment in Fig. 5 are in terms of the span L, they were multiplied by 221 before being entered in Table III. All values for horizontal loading were tabulated similarly to those for vertical loading but under the columns labeled "Hor. comp."

To obtain the reactions or moment at the springing, the totals due to the horizontal components of loading are added to the totals due to the vertical components of loading. The moment, shear, or thrust at any section can then be determined by simple computations of statics.

Influence lines for moment at any section of a hingeless arch of constant section can be obtained, by simple computation, using the values in Tables I and II. Such influence lines would be necessary in dealing with moving loads.

TABLE II. Influence values at right springing—horizontal loading

Influence Values at Right Springing for	h/L	Position of Load 0.1L	0.2L	0.3L	0.4L	0.5L	0.6L	0.7L	0.8L	0.9L
Parabolic arch:										
Moment	0.1	.0039L	.0096L	.0127L	.0128L	.0123L	.0136L	.0178L	.0232L	.0221L
	0.2	.0078L	.0189L	.0246L	.0247L	.0238L	.0261L	.0345L	.0449L	.0434L
	0.3	.0119L	.0280L	.0358L	.0348L	.0344L	.0391L	.0496L	.0650L	.0636L
	0.4	.0158L	.0369L	.0469L	.0463L	.0446L	.0493L	.0637L	.0840L	.0837L
	0.5	.0199L	.0460L	.0575L	.0569L	.0545L	.0597L	.0777L	.1026L	.1033L
Vertical reaction	0.1	.0099	.0311	.0533	.0695	.0753	.0695	.0533	.0311	.0099
	0.2	.0206	.0641	.1088	.1410	.1523	.1410	.1088	.0641	.0206
	0.3	.0323	.0989	.1664	.2140	.2310	.2140	.1664	.0989	.0323
	0.4	.0444	.1349	.2252	.2883	.3107	.2883	.2252	.1349	.0444
	0.5	.0566	.1713	.2847	.3632	.3908	.3632	.2847	.1713	.0566
Horizontal reaction	0.1	.1071	.2900	.4296	.4902	.5000	.5098	.5704	.7100	.8929
	0.2	.1108	.2951	.4310	.4905	.5000	.5095	.5690	.7049	.8892
	0.3	.1157	.3007	.4341	.4848	.5000	.5152	.5659	.6993	.8843
	0.4	.1185	.3061	.4382	.4905	.5000	.5095	.5618	.6939	.8815
	0.5	.1216	.3109	.4397	.4921	.5000	.5079	.5603	.6891	.8784
Circular arch:										
Moment	0.1	.0045L	.0084L	.0124L	.0133L	.0127L	.0140L	.0188L	.0250L	.0222L
	0.2	.0099L	.0223L	.0277L	.0281L	.0272L	.0293L	.0366L	.0463L	.0466L
	0.3	.0191L	.0377L	.0452L	.0457L	.0447L	.0471L	.0558L	.0690L	.0720L
	0.4	.0350L	.0578L	.0663L	.0667L	.0658L	.0681L	.0768L	.0911L	.1003L
	0.5	.0581L	.0822L	.0905L	.0915L	.0908L	.0927L	.1002L	.1140L	.1272L
Vertical reaction	0.1	.0101	.0313	.0531	.0687	.0744	.0687	.0531	.0313	.0101
	0.2	.0230	.0662	.1074	.1355	.1454	.1355	.1074	.0662	.0230
	0.3	.0435	.1072	.1624	.1982	.2105	.1982	.1624	.1072	.0435
	0.4	.0724	.1539	.2161	.2552	.2682	.2552	.2161	.1539	.0724
	0.5	.1145	.2037	.2673	.3055	.3183	.3055	.2673	.2037	.1145
Horizontal reaction	0.1	.1167	.2720	.4218	.4911	.5000	.5089	.5782	.7280	.8833
	0.2	.1291	.3174	.4403	.4923	.5000	.5077	.5597	.6826	.8709
	0.3	.1630	.3450	.4524	.4939	.5000	.5061	.5476	.6550	.8370
	0.4	.2110	.3777	.4639	.4955	.5000	.5045	.5361	.6223	.7890
	0.5	.2696	.4075	.4733	.4967	.5000	.5033	.5267	.5925	.7304
Semi-elliptical arch:										
Moment	0.1	.0121L	.0196L	.0229L	.0235L	.0231L	.0236L	.0262L	.0307L	.3365L
	0.2	.0245L	.0370L	.0420L	.0427L	.0423L	.0434L	.0475L	.0548L	.5990L
	0.3	.0360L	.0527L	.0594L	.0595L	.0592L	.0608L	.0656L	.0755L	.0832L
	0.4	.0471L	.0676L	.0749L	.0758L	.0752L	.0769L	.0834L	.0950L	.1054L
	0.5	.0581L	.0822L	.0905L	.0915L	.0908L	.0927L	.1002L	.1140L	.1272L
Vertical reaction	0.1	.0141	.0296	.0424	.0507	.0536	.0507	.0424	.0296	.0141
	0.2	.0355	.0681	.0936	.1097	.1152	.1097	.0936	.0681	.0355
	0.3	.0607	.1116	.1498	.1734	.1814	.1734	.1498	.1116	.0607
	0.4	.0874	.1573	.2082	.2391	.2495	.2391	.2082	.1573	.0874
	0.5	.1145	.2037	.2673	.3055	.3183	.3055	.2673	.2037	.1145
Horizontal reaction	0.1	.2183	.3755	.4641	.4977	.5000	.5023	.5359	.6245	.7817
	0.2	.2413	.3891	.4673	.4957	.5000	.5043	.5327	.6109	.7587
	0.3	.2543	.3974	.4698	.4954	.5000	.5046	.5302	.6026	.7457
	0.4	.2630	.4032	.4719	.4965	.5000	.5035	.5281	.5968	.7370
	0.5	.2696	.4075	.4733	.4967	.5000	.5033	.5267	.5925	.7304

TABLE III. Reactions and moment at right springing due to loading in Fig. 8(*b*)

A	Load (kips)	Hor. Comp.	Vert. Comp.	H/kip (Hor. Comp.)	H/kip (Vert. Comp.)	H for Hor. Comp.	H for Vert. Comp.	V/kip (Hor. Comp.)	V/kip (Vert. Comp.)	V for Hor. Comp.	V for Vert. Comp.	M/kip (Hor. Comp.)	M/kip (Vert. Comp.)	M for Hor. Comp.	M for Vert. Comp.
.075	2.6	1.390	2.20	.080	0.120	0.11	0.26	.012	.020	.02	0.04	1.216	1.658	1.69	3.65
.145	2.5	1.118	2.24	.220	0.340	0.25	0.76	.038	.062	.04	0.14	2.939	5.127	3.29	11.48
.221	1.6	0.560	1.50	.340	0.665	0.19	1.00	.067	.132	.04	0.20	4.464	8.509	2.50	12.76
.300	4.4	−1.110	−4.26	.435	0.950	−0.48	−4.05	.094	.223	−.10	−0.95	4.508	10.873	−5.00	−46.32
.377	5.4	−0.836	−5.34	.483	1.190	−0.40	−6.36	.113	.320	−.09	−1.71	5.481	11.404	−4.58	−60.90
.459	5.4	−0.283	−5.39	.497	1.310	−0.14	−7.06	.120	.440	−.03	−2.37	5.083	9.437	−1.44	−50.87
.541	5.4	0.283	−5.39	.503	1.310	0.14	−7.06	.120	.560	.03	−3.02	5.194	5.216	1.47	−28.11
.623	5.4	0.836	−5.34	.517	1.190	0.43	−6.36	.113	.680	.09	−3.63	5.790	−0.774	4.84	4.13
.700	5.4	1.361	−5.23	.565	0.950	0.77	−4.97	.094	.777	.13	−4.06	7.072	−6.741	9.63	35.26
.779	4.5	1.578	−4.22	.660	0.665	1.04	−2.81	.067	.868	.11	−3.66	8.442	−11.934	13.32	50.36
.855	4.4	1.965	−3.94	.780	0.340	1.53	−1.34	.038	.938	.08	−3.42	9.105	−13.813	17.89	54.42
.925	4.7	2.510	−3.98	.920	0.120	2.31	−0.48	.012	.980	.03	−3.90	8.288	−11.050	20.80	43.98
					Totals	5.65	−38.47			0.35	−26.34			64.41	29.84

Horizontal reaction at right springing = 5.65 + (−38.47) = −32.82 kips (to the right)
Vertical reaction at right springing = 0.35 + (−26.34) = −25.99 kips (downward)
Moment at right springing = 64.41 + 29.84 = 94.25 ft-kips (counterclockwise)

AMERICAN SOCIETY OF CIVIL ENGINEERS

Hydraulics Division Conference

University of Wisconsin Memorial Union **Madison, Wis.** **August 22–24, 1956**

Co-hosts, University of Wisconsin and Wisconsin Section

REGISTRATION

Union Theater Lobby

4:00–8:00 p.m., Tues., Aug. 21
8:00 a.m. to 8:00 p.m., Wed., Thurs., and Fri., Aug. 22–24.

Registration fee, $2.00.

First Session

WEDNESDAY MORNING

AUG. 22

Union Theater

Presiding: Carl E. Kindsvater, Member, Executive Committee, Hydraulics Division; Gerald H. Jones, Chairman, Committee on Floods

9:30 Welcome by

ARNO T. LENZ, M. ASCE, President, Wisconsin Section; Prof. of Civil Eng., Univ. of Wisconsin.

Greetings from the University

KURT F. WENDT, Dean, College of Engineering, Univ. of Wisconsin.

Floods

10:00 The Floods of December 1955 in California

WALTER G. SCHULZ, M. ASCE, Asst. State Engr., Sacramento.

10:25 Discussion from floor

10:40 Damage From the December 1955 Floods in California

FRANK KOCHIS, A.M. ASCE, Chief, Eng. Div., Sacramento Dist., Corps of Engineers, Sacramento.

11:05 Discussion from floor

11:20 The Effect of Floods on Agriculture

JOSEPH I. BURNS, J.M. ASCE, Sen. Hydraulic Engineer, Calif. Div. of Water Resources, Sacramento.

Second Session

WEDNESDAY AFTERNOON

AUG. 22

Union Theater

Presiding: J. B. Tiffany, Chairman, Executive Committee, Hydraulics Division; Herbert S. Riesbol, Member, Committee on Hydrology

Hydrology

1:45 Snowmelt Runoff in Wisconsin

J. HAROLD ZOLLER, M. ASCE, Prof. of Civil Eng., Univ. of Wyoming, Laramie, Wyo.; and ARNO T. LENZ, M. ASCE, Prof. of Civil Eng., Univ. of Wisconsin, Madison, Wis.

2:10 Discussion from floor

2:25 Measurement of Stream Flow Under Ice Conditions

A. M. MOORE, A.M. ASCE, Asst. District Engineer, U. S. Geological Survey, Portland, Ore.

2:50 Discussion from floor

3:05 Losses Due to Ice Storage in Heart River Between Heart Butte Dam and Mandan, N. Dak.

H. M. ERSKINE, M. ASCE, U. S. G. S., Bismarck, N. Dak.

3:30 Discussion from floor

3:45 Winter Operations of Hydroelectric Plants

W. G. FIELDER, M. ASCE, Area Operating Supt., Niagara Mohawk Power Corp., Potsdam, N. Y.

4:10 Discussion from floor

LABORATORY INSPECTION

Wed. Evening, Aug. 22

8:00 p.m.

Univ. of Wisconsin, Hydr. and San. Lab.

The inspection will be combined with a little Wisconsin "gemütlichkeit." For convention attendants and their ladies.

Third Session

THURSDAY MORNING

AUG. 23

Union Theater

Presiding: Harold M. Martin, Secretary, Executive Committee, Hydraulics Division; Walter L. Moore, Chairman, Committee on Sedimentation

Sedimentation

9:00 Role of Sedimentation in U. S. D. A. Watershed Programs

F. H. LARSON, M. ASCE, and G. ROBERT HALL, U. S. Soil Conservation Service, Upper Darby, Pa.

9:25 Discussion from floor

9:40 Use of Kellner Jetties for Bank Protection and Channelization in Rivers

E. J. CARLSON, M. ASCE and P. F. ENGER, J.M. ASCE; U. S. Bureau of Reclamation, Denver.

10:05 Discussion from floor

10:30 A Boundary Layer Approach to Roughness in Alluvial Channels

M. L. ALBERTSON, M. ASCE, Prof. of Civil Eng.; and S. M. ALI; Colorado A. and M. College, Fort Collins, Colo.

10:55 Discussion from floor

11:10 Hydraulic Factors Determining the Suspended Load

E. M. LAURSEN, A.M. ASCE, Research Engineer, Iowa Inst. of Hydraulic Research, Iowa City.

11:35 Discussion from floor

HYDRAULICS DIVISION BANQUET

Thurs. Evening, Aug. 23

7:00 p.m.

Program and entertainment to be announced.

A nationally known person will give the main address. Ladies are invited.

COMMITTEES

Arno T. Lenz, *General Chairman*

COMMITTEE	CHAIRMAN
Housing,	Prof. G. A. Rohlich
Registration,	Prof. J. R. Villemonte
Milwaukee Program,	R. R. Claypool
Ladies Program,	Mrs. J. G. Woodburn
Madison Entertainment,	Prof. J. G. Woodburn
Transportation,	F. T. Schaefer
Publicity,	Don Johnson
Finance,	H. A. Goetsch, K. R. Wright

Fourth Session

THURSDAY AFTERNOON

AUG. 23

Union Theater

Presiding: John F. Ripken, Member, Committee on Research

Research

1:45 Elementary Construction and Use of Electric and Electronic Computers for Solution of Hydraulic Problems

VINCENT C. RIDEOUT, Assoc. Prof. of Electrical Eng., Univ. of Wisconsin, Madison, Wis.

2:10 Discussion from floor

2:25 Some Analog and Digital Computing Techniques Applied to Non-Steady Open-Channel Flows

JAMES A. HARDER, Research Engineer, Univ. of California, Berkeley.

2:50 Discussion from floor

3:05 Application of Electronic Computers to River Regulation and Power Generation on Missouri River

R. J. PAFFORD, JR., Head Hydraulic Engineer and Chief, Reservoir Control Center, Missouri River Div., Corps of Engineers, Omaha, Nebr.

3:30 Discussion from floor

3:45 A Simplified Graphical Method for Determining Backwater Profile

FRANCIS F. ESCOFFIER, A.M. ASCE, Mobile District, Corps of Engineers, Mobile, Ala.

4:10 Discussion from floor

Fifth Session

FRIDAY MORNING

AUG. 24

Union Theater

Presiding: W. M. Lansford, Vice Chairman, Executive Committee, Hydraulics Division; Leslie J. Hooper, Member, Committee on Design

Design

9:00 Energy Dissipation in Vertical Stilling Basins

M. L. ALBERTSON, M. ASCE, Prof. of Civil Eng., Colorado A. and M. College, Fort Collins, Colo.

9:25 Discussion from floor

9:40 Pipe Friction Loss at High Pressures

J. G. SLATER, Chief Engr., W. C. Heath Associates, Inc., Milwaukee, Wis.; J. R. VILLEMONTE, A.M. ASCE, Assoc. Prof. of Civil Eng., Univ. of Wisconsin, Madison, Wis.; H. J. DAY, Senior Project Engr., Scott Paper Co., Glen Falls, N.Y.

10:05 Discussion from floor

10:30 Practices of Waterways Experiment Station in Design of Hydraulic-Jump Stilling Basins

FREDERICK R. BROWN, M. ASCE, Hydraulic Engr., Waterways Experiment Station, Vicksburg, Miss.

10:55 Discussion from floor

INSPECTION TRIP

Friday Afternoon, Aug. 24

Inspection trip to Allis-Chalmers Manufacturing Co. Plant at West Allis, Wis., near Milwaukee.

12:30 Bus leaves Madison for Milwaukee
Those with private cars will be given instructions for the trip.

2:30 Arrive at Allis-Chalmers Plant

3:00 Tour of West Allis Works

5:00 Tour completed

5:30 Dinner
At Allis-Chalmers clubhouse as guests of the Company.

BASEBALL GAME

Friday Evening, Aug. 24

Milwaukee County Stadium

Milwaukee Braves play Philadelphia Phillies.

8:00 p.m. Play ball
Tickets $1.85 each. Madison to Milwaukee round-trip bus fare, plus baseball ticket, $4.75 each.

Milwaukee bus transportation to the game will be provided for those who drive their own cars to the city, if this is desired.

LADIES' AND CHILDREN'S PROGRAM

Informal swimming, fishing, and boating from the University Dormitory area.

Tours as desired.

State Capitol

State Historical Society Museum
Exhibits of Indian lore and pioneer days, industry, agriculture, paintings, statues, costumes, dolls, and other interesting things.

Biological and Geological Museums
Exhibits of fungi, fossils, shells, native birds, insects, reptiles, deep-sea animals, geologic diorama, etc.

University Arboretum, Wild Life Refuge Preserve
One of the outstanding areas of the kind in the United States is the University Arboretum, 3 miles from the University across Lake Wingra from Vilas Park. It contains over 1200 acres. Plants, shrubs, wild flowers, and trees native to Wisconsin grow there. Restoration to its original state brings back migratory game, woods, and upland birds, and many of the smaller animals.

U. S. Forest Products Laboratory
The first institution of its kind in the world and still the only one in this country. Equipped with precision instruments for testing new building materials or wood.

Unitarian Church
Designed by the internationally known architect, Frank Lloyd Wright, this church is an outstanding architectural achievement.

Vilas Park Zoo
Fine zoo with elephants, camels, bear, deer, monkeys, buffalo, lions, birds, etc.

TRAVEL

Many round-trip tickets can be obtained to Madison with return via Milwaukee. In some cases, it may be a little cheaper to buy the round trip to Milwaukee with arrangements to come via Madison.

Those traveling by rail should make specific inquiry at the time tickets are purchased to insure the most convenient and/or economical travel arrangements.

Those who come by air should decide well in advance which arrangements are most suitable, make reservations early, and purchase tickets accordingly. It is sometimes impossible to get reservations on desired flights on short notice.

HOUSING

ACCOMMODATIONS

Dormitories

Housing is available for both single men and families at the University Residence Halls on the shore of Lake Mendota, a five-minute walk from the Memorial Union Building, where meetings will be held.

Rooms are available for one, two, or three persons per room. The rates are $6.00 per day, American Plan, with food served at Van Hise Hall, next door to the dormitories.

Charges will be computed from the time a person registers to the time

he leaves, at the following rates: breakfast $0.75, lunch $1.00, dinner $1.50, room $2.75. Allowance will be made for absence at the time of the banquet. Children 6 years and under are charged half price. To obtain these low rates, payment is required when registering.

Swimming, fishing, and boating can be enjoyed directly from the lake shore at the dormitories or nearby boathouse.

For dormitory reservations, please contact Prof. J. R. Villemonte, Registration Chairman, Hydraulic Laboratory, Univ. of Wisconsin, Madison 6, Wis.

For hotel or motel reservations delegates should make reservations directly with the reservations clerk of the hotel or tourist court of their choice as early as possible.

HOTELS

The major hotels are in the downtown area, about one mile from the campus. Rates for singles are for one person per room, and rates for double and twin bedrooms are for two people. Larger rooms and suites are also available. Usually up to two cots can be added in a double room.

Hotel	Rates	Air Conditioned
Belmont Hotel:		
Single	$ 4.00–5.00	No
Double	$ 5.50–7.00	
Twin	$ 9.00	
Edgewater Hotel:		
Single	$ 8.00–10.00	All
Double	$12.00	
Twin	$15.00–20.00	
Loraine Hotel:		
Single	$ 4.25–6.75	Yes
Double	$ 7.50–10.50	
Twin	$10.00–13.00	
Park Hotel:		
Single	$ 3.25–8.50	No
Double	$ 5.00–11.50	
Twin	$ 8.00–12.00	

MOTELS

There are many motels of wide variety and quality in the Madison area. Most of them are on the Highway 12 and 14 beltline around the city. Two typical motels are listed below. These are about three to four miles from the campus. It is suggested you contact the AAA or your favorite gasoline touring service for an approved list.

Motel	Rates	Air Conditioned
Mayflower Motel:		
Single	$6.00	Yes
Double	$8.00	
Twin	$9.00	
Vikingtown Motel:		
Single	$5.00–6.00	No
Double	$9.00	
Twin	$9.00	

THE READERS WRITE

Saline water conversion costs vary with salinity and process

To the Editor: The title of the article by David B. Smith and Charles E. Richheimer, on page 60 of the April issue, "Cost Estimates Favor Electrodialysis for Treatment of Saline Water," is completely misleading. This phrasing implies that the cost estimates refer to the entire range of saline water and to all processes used to treat it, and it further implies a certain finality, whereas this is a research problem which is only now attracting extensive scientific attention. There is still need for a great deal of original thinking if the cost of converting saline water is to be reduced to the low prices we are accustomed to paying for water in this country.

In addition to the one cost comparison which was given—for a slightly brackish water of 1,617 ppm salinity, it is suggested that the article might also have included cost estimates for brackish water of 10,000 ppm salinity and for sea water, which has a salinity of 35,000 ppm. These latter cost comparisons would have measurably changed the situation, to the disadvantage of electrodialysis and to the advantage of other processes, such as distillation.

These comments are not intended to disparage electrodialytic treatment as such. In fact, a research group in Holland is developing an electrodialytic process that may be even more economical than the system reported on in the article.

The January 1956 Annual Report of the Secretary of the Interior on Saline Water Conversion is an impartial report on all conversion processes, including electrodialysis, which has received a great deal of attention under this program. Copies can be obtained from the Director, Offices of Saline Water.

Allen Cywin, J.M. ASCE
Office of Saline Water, Dept. of the Interior
Washington, D.C.

Evaporators economical for seawater

To the Editor: I was pleased to see the article, "Cost Estimates Favor Electrodialysis for Treatment of Saline Waters," by David B. Smith and Charles E. Richheimer, in the April issue. Because of the traditional division of interest among various types of engineers in engineering, there has been a natural tendency for civil engineers to think of water supply in terms of wells, dams, and aqueducts, and the possible alternative solutions to water shortages have been left in the hands of the mechanical and chemical engineers. The sooner each group of engineers becomes fully aware of what the other is doing, the more rapid will be the progress towards providing the optimum solution in each particular case of need. Articles such as this one certainly go a long way toward filling this need for communication among engineers.

I would like to take issue, however, with two points in the authors' treatment of the subject.

First, the wording of the title and the arrangement of the text were such that the casual reader could easily gain a very wrong impression of the authors' thesis. Careful reading of the text makes it abundantly clear that the authors' analysis is only for mildly saline waters, that is, water of salinities of, say, 2,000 parts per million or less. In the last paragraph, the authors state that "It is not yet possible . . . to recover usable water from moderately saline waters at costs competitive for conventional water treatment and supply methods."

To this I must add that it is even more out of the question for full-strength sea water. However, the cost of evaporation processes is substantially constant with respect to salt content of feedwater, that is, the cost of producing distilled water from sea water or even more concentrated brines will not be noticeably different from the cost of producing distilled water from fresh-water feeds. This statement will be modified only to the extent that, with dilute feedwaters, it is possible to mix some of the distilled water produced by evaporation with the raw feedwater, as was done in the authors' analysis.

The cost of electrodialysis, on the other hand, increases radically with the salinity and for both economical and practical reasons it appears at present that electrodialysis is out of the question for the more heavily saline inland waters as well as for full-strength sea water. These conclusions were implied by the authors, and to a certain extent were expressed, but were stated in such a way that the casual reader could easily overlook them.

Second, I believe that the values used

(*Continued on page 100*)

SOCIETY NEWS

Water Use Is Dominant Note of Knoxville Technical Program

Planning obviously comes naturally to the engineers of the Tennessee Valley Section, whether it is multi-purpose hydro projects or conventions. At the recent Knoxville Convention, over 900 ASCE members, their wives and guests were treated to a program of ultra-modern technology seasoned with homespun sociability that will linger long in their memories. Guests and members from places as far away as India, Japan, Portugal, Italy, Venezuela and France attended and participated in the technical programs.

George P. Palo, president of the Tennessee Valley Section, gives ASCE President E. R. Needles a preview of Convention plans. Photos from "Knoxville Journal"

Symposium on Arch-Dam Design

Although it would be difficult to choose one session more outstanding than any other, the Power Division presented a program of exceptional interest. Under the chairmanship of R. A. Sutherland, a 14-paper symposium on arch-dam design and construction presented papers by the leading dam engineers throughout the free world. Some of these papers have already been made available in the Power Division Journal; the remainder will appear shortly in the Journal.

Conditions of Practice Session

The Wednesday morning session of the Department of Conditions of Practice on Employer-Employee relations resulted in perhaps the most spirited discussion of the Convention. Papers presented the views of employer and employee in both private and public work. As usually happens in such programs the discussion dwelt at some length on unionism. Harry A. Wiersema, assistant to the chief engineer of the TVA, outlined the successful experience of the Tennessee Valley Authority Engineers Association in furthering the economic status of TVA engineers.

It was the feeling of some of the speakers that in large engineering organizations, communication between employers and employees is at best difficult and that a collective bargaining unit is an asset to smooth relations. The view was expressed that in small offices a union is not necessary to adequate liaison between employees and management. The papers further did an excellent job of pinpointing both the employer's responsibility to his employees and the responsibility of the employee to his boss. The discussion which followed the prepared talks could

Reed Elliot (second from left in left-hand view), president of Knoxville Branch of the host Section and one of the participants in Wednesday's Multiple-Purpose River Development session, discusses Society affairs with Past-Presidents W. R. Glidden (left) and D. V. Terrell and President Needles. View at right shows new ASCE President designate Mason L. Lockwood and Mrs. Lockwood receiving the congratulations of Graham P. Willoughby, ASCE Director for District 10.

have lasted profitably for some time had it not been necessary to adjourn for the general membership luncheon.

Membership Luncheon

More than 420 attended the membership luncheon, which was addressed by Nathan W. Dougherty, dean of engineering at the University of Tennessee. Dean Dougherty declared that "engineering education has reached a point where students will be well served if they have a formal course of some kind, which introduces them to codes of practice and the general obligations resting on professionals."

In discussing the various proposals for engineering education policies, Dean Dougherty stated, "I have reached the conclusion that educational maturity is the objective, rather than the coverage of a wide range of topics. This comes by reading and formal study and also by growing older. If a young man can devote four or five or six years to higher education, he should use his time to achieve the highest possible intellectual development. I am sure that one of the elements is depth of perception which is attained by sequence of courses which lead to advanced engineering. There is little educational growth in the study of more and more sophomore subjects which any intelligent student can read on his own."

At the conclusion of his address, Dean Dougherty received a beautifully illuminated scroll from the Tennessee Valley Section in recognition of his outstanding achievements in education and his contributions to the profession.

Session on Multi-Purpose River Development

The general Wednesday afternoon session was devoted to a six-paper symposium on "Multi-Purpose River Development." The program included such luminaries as H. D. Vogel, chairman of the TVA; W. A. Dexheimer, U. S. Commissioner of Reclamation; Gail A. Hathaway, Past-President of ASCE and special assistant to the Chief of Engineers; Reed A. Elliot, chief water control planning engineer for the TVA; G. O. Wessenauer, manager of power for the TVA; and E. R. DeLuccia, vice-president and chief engineer of the Pacific Light and Power Co. The articles by General Vogel and Mr. Wessenauer appear in this issue. The others are scheduled for subsequent issues.

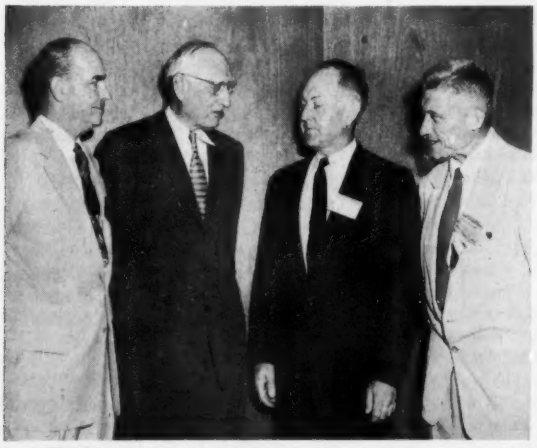
In speaking of the future of multi-purpose developments, Commissioner Dexheimer said that he anticipates even greater emphasis will be placed upon multi-purpose basin development in the future. "Where possible," he stated, "this future process should fit into an overall basin plan which should be investigated and outlined in advance of construction." He predicted increased "local and state participation in planning, construction and operation of multi-purpose facilities, although by the very nature of interstate rivers and problems connected with their development, strong national leadership is essential."

The basic logic of multi-purpose river development was seconded by ASCE Past-President Hathaway when he declared, "Because of the many inherent advantages in multi-purpose development of meeting effectively the needs of flood control, navigation, hydro-power, irrigation, domestic and industrial water supply, and other water uses with a minimum of conflict and with much greater economy, we have every reason to expect that, in the main, future development of water resources will be by multiple-purpose means."

Against impressive backdrop of TVA system, A. E. Morgan, Hon. M. ASCE and first chairman of TVA, chats with ASCE Director Samuel Morris, of Los Angeles. Photo from "Knoxville News-Sentinel"

In speaking before a large audience of structural engineers, Gibson Morris, chief engineer of the Oak Ridge National Laboratory, advised "as we enter the atomic era and as engineers in all fields become more actively engaged in designing facilities peculiar to the development of atomic energy, we must become acquainted with the new conditions which invariably must be considered in new facil-

In lower left view Brig. Gen. Herbert D. Vogel, present chairman of the TVA, joins first TVA Chairman A. E. Morgan (second from left), Hon. M. ASCE, in discussing water use in the Valley with Norman R. Moore (second from right), chief of the Engineering Division, Vicksburg, and Harry Wiersema, veteran TVA employee. At lower right Convention Chairman Don H. Mattern (center) relaxes from official duties to chat with ASCE Director Ernest W. Carlton and Past-President D. V. Terrell.



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Georgia delegation, up from Atlanta, puts heads together in lobby of Hotel Andrew Johnson. Shown, left to right, are Gordon B. Dalrymple, Burton Bell, Warren Mann, Moses Cox, and Byron Bledsoe. Photos courtesy of "Knoxville Journal."

In upper photo, ASCE Director George Richardson (right) is congratulated by Director C. L. Eckel, his former professor at the University of Colorado, now dean of the engineering school there, on winning an honorary engineering doctorate from the university. Lower view shows Dean Nathan W. Dougherty receiving an illuminated scroll from President Needles in recognition of his "outstanding contribution to engineering on the national and local level, and specifically for his services to ASCE."

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ity design." Mr. Morris' remarks were in connection with a unique structure of steel towers capable of suspending 55 tons of radiation source 200 ft above the ground. The source had to be sufficiently distant from any mass such as the ground or supporting structure to enable measurement of the radiation surrounded by nothing but air.

The Structural Division, in a unique approach to programming, presented four comprehensive sessions, each fully exploring such subjects as ultimate design, thin shells, and prestressed concrete. The sessions were well received by a large and enthusiastic audience.

Highways Studied

For many American cities of 10,000 to 150,000 population which, like large metropolitan areas, have traffic problems, but which cannot justify or economically finance expressways, the solution seems to be a comprehensive "Land Use Plan." This opinion was expressed by Prof. Willard F. Babcock, of North Carolina State College, in a paper before the Highway Division. Such a plan, he said, "represents a comprehensive analysis of existing land use, land densities, population trends, and probable economic development." The plan then developed should give a reasonable picture of what the urban area will look like perhaps 20 years in the future.

President Needles Gives Annual Address

President Needles, at a well-attended luncheon on Thursday, delivered the president's annual address, entitled "Our Exciting Profession." The address is abstracted in this issue and will appear in its entirety in Volume 121 of TRANSACTIONS.

Dr. Morgan Addresses Hydraulics Dinner

Conventioneers had their choice of dinner meetings, as both the Hydraulics and Structural Divisions planned evening affairs on Thursday. For the hydraulics people of the Tennessee Valley, it was a particular pleasure to welcome Arthur E. Morgan, Hon. M. ASCE, whose organizational genius was largely responsible for the success of TVA from its inception through 1939. Dr. Morgan paid his respect to the "little gang of men who were masters of every phase of the job they undertook, and who gave the TVA a running start." In particular, he mentioned the late Sherman Woodward, Hon. M. ASCE, of whom he said that among three thousand men he had employed or supervised including some thousand on TVA, "I should put this modest, unassuming man first for clarity of insight in his field." He also acknowledged the contribution of such TVA stalwarts as Carl Bock, Barbour Jones, the late Ned Sayford, and Charlie Locher. In the hydraulics and river-planning field he singled out Albert Fry, Harry Wiersema and James Bowman.

In speaking of the creation of TVA Dr. Morgan stated, "For the TVA to emerge into actual existence required a remarkable coincidence of conditions. Senator Norris was a factor, but his imagination covered far less than the whole. The controlling cause was a President [Franklin D. Roosevelt] with a remarkable range of creative imagination, readiness to break with social, political, and industrial precedent, and a great concentration of political power. With whatever ideas came from others, the total picture developed in his mind."

In speaking of the Authority itself, Dr. Morgan went on to say that, "The TVA has in it something of a new creation, of new ways for handling some of our common public needs. This has been recognized the world over. Such new ways being rare, when one does appear that has promise, we should cherish it to the extent of giving it a chance to disclose its possibilities. To thwart, distort or mutilate it, so that its possibilities may never be fully disclosed may be an historic loss. But also to deify it, to idealize it, to hold it to be above critical and realistic appraisal, may give it place among sacrosanct social dogmas, to be credulously accepted or violently opposed, but not to be subjected to real inquiry."

The speaker noted that TVA has suffered from both these attitudes.

At the dinner the Hydraulics Division honored Al Fry for his many years of devoted service to the field of hydraulics and particularly to the Division itself.

Structural Division Dinner

On the same evening that the hydraulics engineers were gathered at the university, over 200 structural engineers met for dinner at the Andrew Johnson in Knoxville to hear Maj. Gen. Lee D. Washbourne, assistant chief of staff, Installations, USAF. Paying tribute to the engineering profession, General Washbourne stated that the forces and facilities supporting the air power of the United States, "reflect the technical and professional ability of the engineer to match the ever-increasing performance of weapons systems." The Air Force construction program, said the General, may be epitomized in five words, "$10 billion and 10 years." He further noted that "we are three-quarters of the way along with the job of providing the base structure for the 137-wing force." Of all engineers in the Air Force he said, "about 70 percent are civil engineers." However he noted that the increasing complexity of electronic control devices tends to change the balance in favor of electrical and mechanical engineers. In outlining the extremely broad scope of Air Force construction responsibilities, General Washbourne commented that, "the aviation world is looking to USAF experience, for criteria related to airfield pavements satisfactory for jet aircraft use."

With regard to personnel, the General sounded a pessimistic note when he said, "Our military personnel are being rotated between the United States and overseas with undesirable frequency, and school quotas to further the education of the junior half of our office corps are frequently left unfilled."

Exciting Social Program, Too

The social aspects of the Knoxville Convention were as well planned by the host Section as was the technical program. With a thoughful eye to costs, only one function was as much as $4.00, and all the rest were less. Wednesday evening, after an excellent dinner served by the university, the conventioneers were entertained by an exhibition of country dancing by the Wagonwheelers of Marysville, Tenn. A medley of mountain ballads was rendered by an unnamed motley of mountaineers. Jugs in hand, they wrung the hearts of the assemblage with a soulful rendition of "Falsehearted Lover." The mountaineers, it turned out, were TV Section members, Bob Buehler, Bob Forbes, and John Voorhees. The fourth member of the quartet, also concerned with bridges but not an engineer, was T. R. Lane, a local dentist.

The entertainment was followed by a strenuous and warm session of square dancing that was vigorously enjoyed by all. Calling the dances was T. W. Kleinsasser who, when not calling squares, is a meteorologist for the TVA.

The Thursday evening dinners were followed by a special performance at Knoxville's Carousel Theater of "Three Men on a Horse." The show couldn't have been more enjoyed on Broadway.

During the day about 100 of the engineers' ladies were taken on a tour to New Found Gap, where President Franklin Roosevelt once dedicated Great Smoky Mountain National Park. The tour included an excellent luncheon at the inn in Gatlinsburg, an illustrated talk on the flowers and animals of the Smokies by the Park's naturalist, and a tour of the mountain craft shops. Each guest was given a souvenir from the famed Pigeon Forge potteries. It was noted that the craftsmanship and artistry of these people would stand comparison with the best in the country.

Oak Ridge Visited

For those who had heard so much about it and never been there, the tour of Oak Ridge National Laboratory was a high spot of the Convention. The group was shown the original graphite-moderated thermal reactor and the new swimming-pool reactor similar to the unit displayed by the United States at Geneva. The biggest part of the operation at Oak Ridge is the production of radioisotopes for research and medical uses. The production, handling, and packaging of these was explained in detail and demonstrated to the visiting ASCE members. Certainly a great deal about nuclear reactors and fissionable material was clarified for the civil engineers fortunate enough to attend.

Tour of Tennessee Valley Dams

The Convention was climaxed by an all-day tour on Saturday of some of the Tennessee Valley installations. A registration of about twenty had been expected but sixty-seven showed up for this wonderful trip, which was free. A cavalcade of four private cars followed the official bus—a big, comfortable air-conditioned one that snaked around the hairpin turns as if it had a hinge in the middle. Wylie Bowmaster was ASCE guide for the trip. The party also included C. E. Blee, Reed Elliot, and B. C. Moneymaker to answer specialty questions on the way.

The first stop was at Chilhowee Dam, an Alcoa project on the Little Tennessee River, with Tainter gates 35 ft wide and 38 ft high. Chilhowee Dam will be completed in 1957. The next stop was at Old Calderwood Dam, where the group were luncheon guests of the Aluminum Company of America. More of a banquet than a luncheon was the verdict of the fortunate ones treated to this "typically Southern" meal. The afternoon stops were at Cheoah and Fontana dams, where the powerhouses were also visited.

Orchids to the Host Section

It would be folly to attempt to give full credit to all those who contributed to making the Convention such a success. Above all it was a team effort that resulted in the smooth program. Even so mention must be made of the excellent jobs done by Don Mattern, general chairman of the Convention; Gale Dougherty, chairman of the technical program; and George Palo, this year's president of the host Section. The ladies' program was under the chairmanship of Mrs. C. E. Blee, but again the cordiality and courtesy extended to the visiting ladies was the work of many—such as Mrs. Mattern and Mrs. J. E. Goddard, to mention two—who did so much to make the engineers and their wives feel at home.

Five New Honorary Members Elected

Five members of ASCE were elected to honorary membership in ASCE during the Knoxville meeting of the Board of Direction. They are George W. Burpee, Albert Haertlein, Maj. Gen. Thomas M. Robins, Ole Singstad, and Ralph B. Wiley. All have accepted, and their biographies and photographs will be published in the October issue.

A prominent New York City consultant, Mr. Burpee is senior member of the firm of Coverdale & Colpitts, with which he has been connected since 1921. His firm is especially well known for its engineering studies for mass rapid transit facilities. In recent years it has prepared engineering estimates of traffic and revenue for over 200 important bridge and express highway projects. Mr. Burpee served ASCE as Director from 1942 to 1944 and Vice-President in 1952 and 1953, and is prominent in many other professional societies and civic works.

An authority in engineering and scientific teaching, Albert Haertlein is associate dean of engineering and applied physics and Gordon McKay Professor of Civil Engineering at Harvard University, to which he has devoted most of his career. As a member of the Massachusetts Board of Professional Engineers and Land Surveyors since its formation in 1942, Dean Haertlein has been actively concerned with problems of professional practice as well as

with engineering education. His long and devoted service to ASCE has included terms as Director (1946 to 1948) and Vice-President (1950 and 1951).

General Robins has had a distinguished career in the Army, which he entered following his graduation from West Point in 1904. As division engineer at Portland, Ore., for a number of years, he supervised a tremendous amount of engineering work, including construction of Bonneville Dam. In the Office of the Chief of Engineers from 1939 until his retirement in 1945, he was the executive agent in supervising the largest civil engineering force under one control ever assembled. After his retirement he returned to Portland, where he has been practicing his profession.

Mr. Singstad, member of the New York City consulting firm of Singstad and Baillie, is widely known as a pioneer and leader in the development of the modern vehicular tunnel for automotive traffic. He has been a consultant on such important projects as the Detroit-Windsor Tunnel, Lincoln Tunnel in New York, the Scheldt River Tunnel at Antwerp, Belgium, and the Pasadena Tunnel in Texas. As chief engineer of the New York City Tunnel Authority from 1935 to 1945, he was a key figure in constructing the Queens-Midtown Tunnel and the Brooklyn-Battery Tunnel. His firm is currently planning, designing, and supervising construction of the Baltimore Harbor Tunnel. Mr. Singstad was Director of the Society from 1930 to 1933, and has also been president of the Metropolitan Section.

Widely known as an engineering educator, Ralph B. Wiley retired in October 1955 as head of the School of Civil Engineering and Engineering Mechanics at Purdue University. He had been connected with the school since 1908, and its active head since 1937. During his administration there was a tremendous increase (almost 600 percent) in the size of the school and in the teaching and research budget. Professor Wiley has combined consulting work with his teaching career, and has also been active in such groups as the Indiana Stream Pollution Control Board and the Indiana Flood Control and Water Resources Commission. He was Director of ASCE from 1941 to 1943 and Vice-President from 1947 to 1949. Since his retirement from Purdue Professor Wiley has been consulting engineer for the Indiana Division of Mental Health.

Actions of Board at Knoxville Meeting Briefed

Actions taken by the ASCE Board of Direction at its two-day meeting in Knoxville, June 4 and 5, covered a wide field. A brief summary of these actions follows.

New Format for Annual Report

Taking cognizance of the fact that a fully informed membership is vital to the continued growth of ASCE and to its effectiveness in serving the profession, the Board directed the Budget Committee to provide an appropriation of $15,000 in the 1956–1957 budget for an annual report to be distributed automatically to all members of the Society, to others on the CIVIL ENGINEERING mailing list, and to the officers of the Local Sections and the Student Chapters. The report is to be a high-quality presentation—clear, concise, readable, and attractive.

Joint Committee on Spillways

An appropriation of $1,000 was authorized to finance the activities of the ASCE-AWWA Joint Task Committee on Spillways. The appropriation matches a similar appropriation of the AWWA.

Honorary Members Named

On the unanimous recommendation of the Committee on Honorary Membership, the Board elected the following five members of the Society to honorary membership: George W. Burpee, Albert Haertlein, Maj. Gen. Thomas M. Robins, Ole Singstad, and Ralph Wiley. A fuller account appears elsewhere in the "Society News" section.

Convention Sites Chosen

The following places and dates were approved for forthcoming ASCE Conventions: Chicago, Ill., February 1958; New York, N. Y., October 13–17, 1958; Washington, D. C., October 19–23, 1959; Reno, Nev., June 19–25, 1960; and Boston, Mass., October 9–13, 1960.

Soliciting Engineering Assignments

Noting that consulting engineers are being approached in increasing numbers by persons soliciting the opportunity to represent them on a commission basis in the securing of engineering assignments, the Board declared such action a violation of the Code of Ethics. In support of this action reference was made to Item 9 of the Code, which states that it is unprofessional and inconsistent with honorable and dignified bearing "To use undue influence or offer commissions or otherwise to solicit professional work improperly, directly or indirectly."

Daniel W. Mead Prize

The subject for the 1957 Daniel W. Mead Prize competition was announced. Both Junior Members and Student Chapter Members will write on the subject, "Under what conditions should faculty members engage in outside professional engineering practice?"

Conditions of Practice

Special task subcommittees were appointed to consider revision of Manuals of Engineering Practice Nos. 29 and 33; to draft a standard form of agreement between client and engineer; and to revise Article 7 of the Code of Ethics (pertaining to advertising).

President Nominated

Accepting the unanimous choice of the Nominating Committee, the Board named Mason G. Lockwood, of Houston, Tex., the official nominee for president of ASCE (item elsewhere in "Society News").

National Highway Program

With the highway bill ready for final congressional action in accord with the aims of the ASCE Task Committee on National Highway Program, the committee was discharged. The Board extended its thanks to the committee and commended its membership for the services it has rendered in helping to rally the profession behind this nationally vital program.

Convention Registration Fee

Article IX Section 2 of the Rules of Policy and Procedure were amended to increase the permissible Convention registration fee from $3.00 to a maximum of $5.00.

Nuclear Congress

ASCE participation in the Annual Congress on Nuclear Engineering, to be held in Philadelphia, Pa., March 10–16, 1957, was confirmed, as was the following policy for future congresses: ". . . it is imperative that an Annual Congress on Nuclear Engineering be held under the general sponsorship of Engineers Joint Council, but under the operating management of a group of representatives of the American Society of Civil Engineers, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Institute of Chemical Engineers on a mutually agreeable basis, which will establish standards for papers and con-

tributions, decide on the general pattern for the meeting, secure the cooperation of local operating groups as needed, and which shall encourage the participation of other engineering and scientific societies which will make contributions in accord with the standards set by the managing group."

Prizes and Awards

On the recommendation of the Committee on Society Prizes, the Board approved prizes and awards for papers published in Transactions and CIVIL ENGINEERING. The awards and winners are listed below.

Group Insurance Plan

Approval was accorded a plan to broaden the ASCE Group Disability Insurance Plan by the development of a "Catastrophe Hospitalization Provision." The new provision, which is optional, is outlined elsewhere in this department.

New Division Authorized

Formation of a Pipeline Division of the Society has been authorized.

Local Section Changes

Upon recommendation of the Committee on Local Sections, the Board approved changing the name of the Northeastern Section to the Massachusetts Section and the Providence Section to the Rhode Island Section. Formation of a St. Lawrence Branch of the Syracuse Section to serve 58 members in the northernmost part of the area was also authorized.

Mason Lockwood Nominated for President

MASON LOCKWOOD
Nominee for President

Mason G. Lockwood, Houston, Tex., consultant and a recent Vice-President of ASCE, was nominated for President of the Society by the Board of Direction at its Knoxville meeting. The nomination will go to the membership for confirmation by letter ballot, and installation will take place in October at the Society's Annual Convention in Pittsburgh.

Since 1935 Mr. Lockwood has been in private practice—first as a member of the firm of Dowdell, Lockwood & Andrews, and later as a member of Lockwood & Andrews. The firm has been closely identified with many important developments in the Gulf Coast region of Texas in recent years, and during World War II participated in the design and supervision of construction of a number of military establishments and defense industries.

A member of ASCE since 1941, Mr. Lockwood completed a two-year term as Vice-President for Zone IV last fall. He was chairman of the Committee on Conditions of Practice. He has also been active in the Texas Section, which he has served as director, vice-president, and president.

ASCE Prizes and Awards Are Announced by Board

On recommendation of the Society's Committee on Prizes, the Board of Direction at its Knoxville meeting approved the following awards and prizes for papers published in Volume 120 of TRANSACTIONS. Presentation will be made at ceremonies held during the Annual Convention in Pittsburgh in October. Further details, together with brief biographies, will appear in a later issue of CIVIL ENGINEERING.

Norman Medal

CARL E. KINDSVATER, M. ASCE, and ROLLAND W. CARTER, A.M. ASCE, for Paper, "Tranquil Flow Through Open-Channel Constrictions."

J. James R. Croes Medal

JACK W. CARTER, A.M. ASCE, KENNETH H. LENZEN, A.M. ASCE and LAWRENCE T. WYLY, M. ASCE, for Paper, "Fatigue in Riveted and Bolted Single-Lap Joints."

Thomas Fitch Rowland Prize

JONATHAN JONES, Hon. M. ASCE, for Paper, "Erection of Main River Span, Passaic River Bridge."

James Laurie Prize

SAMUEL I. ZACK, M. ASCE, for Paper, "Financing of Sewage Works in Pennsylvania."

Arthur M. Wellington Prize

JOHN HUGH JONES, A.M. ASCE, and ROBERT HORONJEFF, A.M. ASCE, for Paper, "Determination of Radii of Curvature of Taxiways."

Collingwood Prize for Juniors

JOHN H. SCHMERTMANN, J. M. ASCE, for Paper, "The Undisturbed Consolidation Behavior of Clay."

On recommendation of the Technical Division Prize Committees, the Board approved the following awards:

Rudolph Hering Medal

THOMAS R. CAMP, M. ASCE, for Paper, "Flocculation and Flocculation Basins."

Leon S. Moisseiff Award

GEORGE S. VINCENT, M. ASCE, for Paper, "Aerodynamic Stability of Suspension Bridges."

James W. Rickey Medal

ADOLF A. MEYER, M. ASCE, for Paper, "Modernization of the Hales Bar Plant."

J. C. Stevens Award

SERGE LELIAVSKY, M. ASCE, for Discussion of Paper, "Design of Stable Channels."

Middlebrooks Award

ALLEN J. CURTIS, Non-member and Frank E. Richart, Jr., A.M. ASCE, for Paper, "Photoelastic Analogy for Non-Homogeneous Foundations."

Construction Engineering Prize

ARVE S. WIKSTROM, A.M. ASCE, for Paper, "Contractor Finds St. Lawrence Bridge Substructure No Picnic," in the December 1955 issue of CIVIL ENGINEERING.

ASCE MEMBERSHIP AS OF JUNE 8, 1956

Members	9,235
Associate Members	11,976
Junior Members	17,816
Affiliates	72
Honorary Members	41
Total	39,140
(June 9, 1955	38,543)

New York Recommended for Engineering Societies Center

The presidents of the four Founder Societies and of the American Institute of Chemical Engineers announced on June 27 receipt of the report of the Special Task Committee of Fifteen (see CIVIL ENGINEERING for September 1955, page 72), appointed to make recommendations with regard to the site of the Engineering Societies Center. Action on the recommendation is to be taken by the several governing boards. The recommendations are as follows:

1. The Engineering Societies Center be located in New York City.

2. The 39th-40th Street site be continued in use as the site of the Engineering Societies Center.

If rebuilding in that area proves impracticable, a comparable site should then be sought in midtown New York.

The Committee of Fifteen suggests that the governing boards also adopt these further recommendations for inaugurating action:

3. The United Engineering Trustees, Inc., be authorized to take proper legal action for expansion by the addition of the American Institute of Chemical Engineers to the incorporators when properly qualified.

4. United Engineering Trustees, Inc., be authorized to raise money and accept contributions; accept the offer of the Kelly Committee (July 1955 issue, page 75); place contributions in UET Capital Fund Assets; employ architects, engineers, and attorneys; let contracts for reconstruction of the present Engineering Societies Building and/or a new building or buildings; pay all costs out of the Capital Fund Assets; and operate and maintain the new Engineering Societies Center.

5. The plans for the new and enlarged Engineering Societies Center be made with ample optimism with respect to the future growth of the five societies immediately involved. These facilities should be such as to attract and hold all of the engineering profession, thus fostering unity and cooperation along broad lines.

The vote of the Special Task Committee, the members of each of the five societies voting as a unit as prescribed, is unanimously in favor of these recommendations.

Influence Peddlers Are at Work

Evidence has been brought to the attention of the Board of Direction and the Committee on Professional Conduct of greatly increased activity on the part of commission agents offering to secure projects for engineering firms. In its meeting at Knoxville the Board stated emphatically that participation in this kind of deal is in direct violation of Item 9 of the Code of Ethics. This section declares it unethical "to use undue influence or offer commissions or otherwise to solicit professional work improperly, directly or indirectly."

The basic qualifications upon which engineering assignments should be made are ability, experience and capacity. This is the underlying concept of negotiated engineering contracts and the basis on which competitive bidding is opposed as unsound. The practice of paying or offering to pay commissions for the procurement of engineering assignments obviously relegates the qualities of ability and experience to a significance secondary to salesmanship and influence.

The practice is an invidious one in that it subverts the public's best interest by substituting invalid criteria for soundness in the award of engineering work. Acceptance or rationalization of this method of conducting engineering practice can only reduce the profession to the level of the market place.

Proceedings of EJC Assembly Available

A discussion of the Reserve Forces Act of 1955 by top representatives of the Selective Service Department of the Department of Defense and the findings of the Hoover Commission of interest to engineers are two highlights of the Proceedings of the Second General Assembly of Engineers Joint Council, which is now available. The 68-page pamphlet contains not only the formal talks at the Second General Assembly, held in New York, January 26 and 27, but also the discussion from the floor during the two-day conference.

Copies, priced at $1.00 each, are available from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

EJC Directory of All Engineering Societies

This summer Engineers Joint Council is publishing an "Engineering Societies Directory," of all local, regional, and national engineering societies. The comprehensive listing includes the name and purpose of each organization, and the name and address of its secretary. Revisions will be issued periodically as required

Persons wishing to order the Directory should take advantage of the prepublication price of $3.50. Orders should be sent to E. Paul Lange, Secretary of EJC, 29 West 39th Street, New York 18, N.Y.

ASCE Insurance Plan Offers Better Protection

Additional insurance benefits will be available to members as of August 1—seventh anniversary of the Society's Group Disability Plan—under a new optional plan, called Catastrophe Hospital and Surgical. Insured members may carry either the old hospital and surgical coverage or the new and much broader protection, but not both.

The important new coverage, which was approved by the Board of Direction at its Knoxville meeting, will defray hospital expenses up to $5,000 for any one accident or illness requiring hospitalization within two years after the accident or start of the illness. Maximum allowance of $15 a day for board and room, 75 percent of miscellaneous hospital expenses, and 75 percent of hospital nursing care are included in this coverage. In addition, if the injury or illness should make it necessary for the insured to undergo an operation, the insurance company will pay the actual expenses incurred. Maximum surgical indemnity resulting from any one accident or illness will be $500.

Members already insured under the original Hospital and Surgical Plan may take advantage of this increased protection by rewriting their coverage as of August 1. The new coverage will be open to all members up to age 70 until November 1. After that date the maximum age for applicants will be 60, although benefits will run to age 70.

A circular letter to the membership, providing full details and enclosing application blanks, will shortly be mailed from the Secretary's office. Smith and Sternau, with offices in New York and Washington, are the administrators of the Society's group insurance plans.

Commercial Credit Building, Baltimore. *Architect:* Harrison & Abramovitz, New York City; *structural engineer:* Edwards & Hjorth, New York City; *general contractor:* Consolidated Engineering Company, Inc., Baltimore.

BIG NEW BUILDING IN BALTIMORE

This is the steel skeleton for Baltimore's handsome new 20-story skyscraper, shown shortly after topping out by a Bethlehem erection crew. Commercial Credit Company, the owner, and its associated companies will occupy the second through the ninth floors, leasing the eleven upper floors, each providing about 12,000 sq ft of usable space. Areas on the ground and mezzanine floors will also provide rental income. A parking garage is located below street level.

Bethlehem ironworkers used high-strength structural bolts — 75,000 of them — in erecting the 4,850-ton steel framework. This was the first use of these modern, efficient fasteners for construction of a multi-story building in Baltimore.

In addition to air-conditioning and sound proofing throughout, design of the Commercial Credit Building includes such features as electronic, operator-less elevators, movable office partitions, non-slip floors and center-pivoted windows. Exterior treatment calls for gunmetal-colored aluminum panels above a first floor facade of Indiana limestone.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

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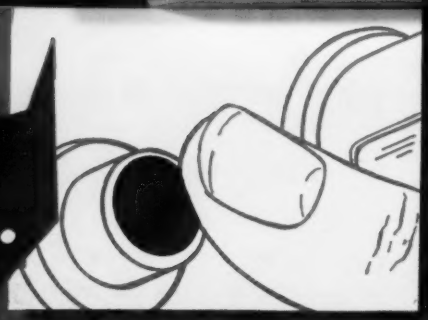
PUSH THIS BUTTON...



Bonus-Powered

Try seconds-fast crawler starting. Famous International gasoline conversion, *in-seat* starting is *standard equipment* in all International diesel models! You get fast, positive, all-weather diesel starting, without *fooling* or *fouling!*

Try the lever-pull ease and power-transfer efficiency that new International Cerametallic engine clutch facings give you. And these self-cooling, long-lasting facings are of long-proved, well-known dry-type clutch design. No mystifying seals, circulators or "cold-sensitive" liquid to live with!

Try new International crawler steering. Unrivaled TD-24 Planet Power steering with capacity-boosting power on both tracks is responsive to even a schoolboy's finger-tip touch! New hydraulic booster steering, in the new TD-18 and TD-14, reduces steering lever pull a big 75%. And the new T-6, TD-6, and TD-9 with spring-type steering clutch boosters are 25% easier to steer!

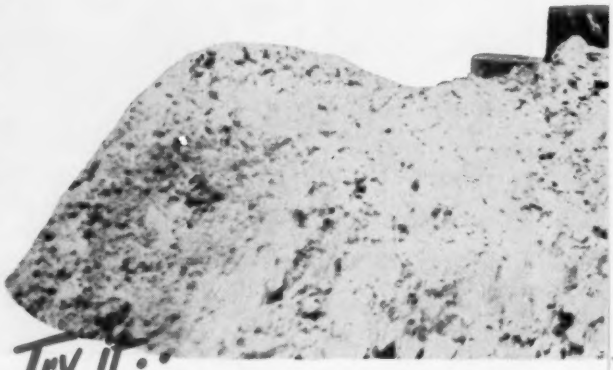
Above all, load up a new International crawler with matched International equipment—prove how bonus-powered performance boosts profit-production, wins operator preference, simplifies servicing. Choose from 7 heavy-duty crawler models, 41.5 drawbar to 200 net engine hp. Have your nearby International Distributor show you the bonus-powered performance package you need! Get a demonstration on your job today!

Try it..

a new Dirt-Heaping, Bid-Beating International Payscraper®! Even where four-wheel prime mover units bogged down and slowed this Rio Grande Floodway Project to a standstill, two new, easy-loading, high-clearance 75 Payscrapers—push-loaded by a TD-24 Torque Converter crawler—were able to complete a critical job on schedule. Compare a payload-boosting new Payscraper to any other two-or four-wheel unit in any operating condition.

Try it..

bonus-powered crawlers . . . matched dozers. This new 103 hp TD-18 (182 Series) is helping build streets in a Saginaw Michigan subdivision—dozing sand with International hydraulic dozer. Operator rides in adjustable, "club-car" comfort—has "control tower" job-bossing vision, and a clean, safe deck with ample "stretch-out" room.



Try it..

a brawny new rock-rugged International Payhauler® . . . for *fast off-highway* hauling. Haul rock or aggregate, ballast, or ore, off-highway—operate at speeds up to 38 mph—try a new 18-ton Model 65, or 24-ton Model 95, International Payhauler. Turbo-charged, diesel-powered with highest hp-to-ton capacity ratio on the market! Strongest main frame sections known. See and try an International Payhauler!

Try new International®
performance on your job!

See you at the
ROAD SHOW
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Jan. 28 - Feb. 2, 1957

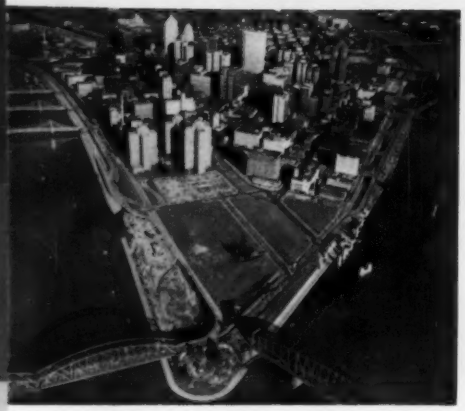
INTERNATIONAL HARVESTER

INTERNATIONAL® Construction Equipment

International Harvester Company, 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Boom Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Trucks . . . Diesel and Carbureted Engines . . . Motor Trucks

Pittsburgh Presses Plans for Annual Convention



Point of the Golden Triangle, as of September 1955, shows how the redevelopment program is beautifying this important and historic area, until recently a congested commercial and railroading district. Plans are being completed for building a state park on the site of Forts Duquesne and Pitt, the two early settlements from which came today's great city.

Mellon Square Park, topping a six-level underground parking garage, is pictured in top photo. Headquarters for the Convention, the William Penn Hotel (in background at right) overlooks this oasis of greenery in the heart of the city. Lower view shows Terminal Building for Greater Pittsburgh Airport.

This year the Society's Annual Convention (and annual meeting, too) will be held in Pittsburgh, October 15-19, with the Pittsburgh Section as host. This pleasant change from the traditional New York meeting will give members and their families a chance to see the amazing new look engineers and planners have given the city in the postwar decade. Under the able direction of Park H. Martin, Hon. M. ASCE, and general Convention chairman, eleven committees are deeply involved in plans that guarantee an exceptional Convention.

Tour of Atomic Power Plant

Carl Jansen, chairman of the Technical Program Committee, reports that all the Technical Divisions will be represented on the Convention program. Of special interest is the Power Division session, scheduled for Tuesday morning and featuring three papers on the Shippingport Power Station—the first atomic energy power plant to be integrated into a utility system. An inspection tour of this important construction project, on Tuesday afternoon, will round out the session. The full Convention program will appear in the August issue.

Annual Business Meeting

Once again members are reminded that the Annual Business Meeting of the Society will be held in Pittsburgh, Wednesday morning, October 17. This annual Convention feature, traditionally held in New York, is being shifted to Pittsburgh this year by special action of the Board.

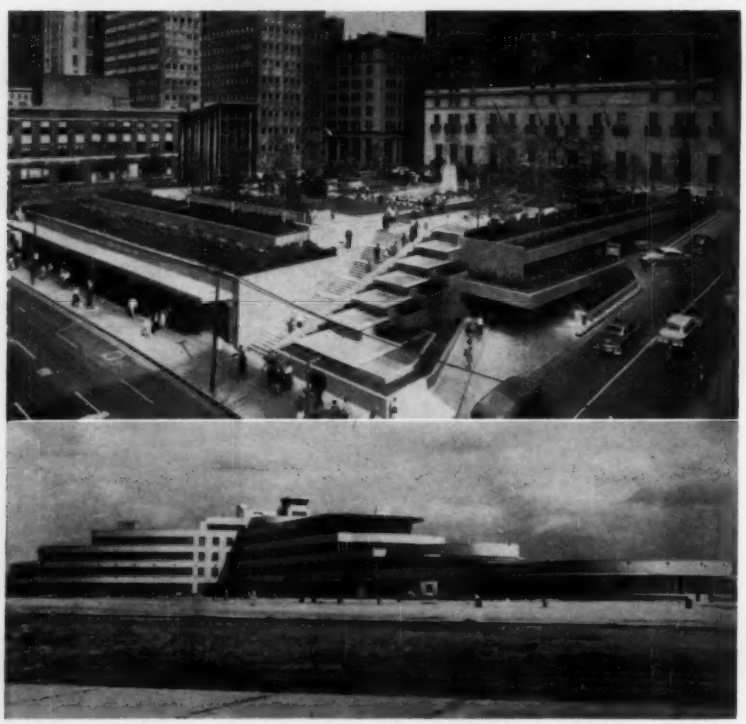
"The New Pittsburgh"

Always of interest as "The Steel City" and a great industrial center, Pittsburgh today epitomizes what can be done in a short time with effective planning and large-scale engineering. Visitors arriving by air will appreciate the comfort and convenience of the $33,000,000 Terminal Building of the Greater Pittsburgh Airport, one of the nation's largest. With a 62-room hotel, a supper club seating 650, every type of shop and recreational facility, and exhibition galleries, the Terminal Building is described as "a city in itself." The motorist to Pittsburgh will immediately be aware of the tremendous new highway development program centering about the Penn-Lincoln Parkway. One of the most complex urban expressways in America, this 27-mile parkway is being completed east and west through the heart of the city. The Etna-Sharpsburg Bypass, now under construction, is one of numerous other new projects, in the works or in the planning stage, aimed at speeding traffic through the city.

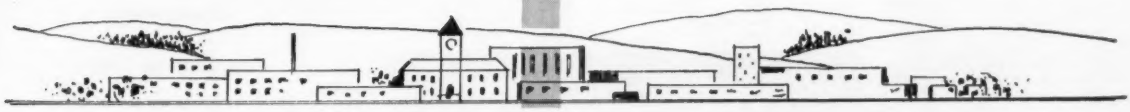
Convention headquarters, the William Penn Hotel, on beautiful Mellon Square Park, overlooks one of five parking garages recently built as another step in eliminating some of the traffic congestion in mid- and downtown Pittsburgh. A six-level underground structure, with room for almost a thousand cars, the garage is topped with the park, which was made possible by a $4,350,000 gift from the Mellon family. The other new parking garages (for about 1,000 cars each) are above-ground structures.

Including Gateway Center and the midtown, 44 new buildings have gone up or are under way in the Golden Triangle, and three other major structures are planned for erection soon.

Persons who haven't been in Pittsburgh in recent years will hardly recognize the famous Golden Triangle, with its many new developments. The Convention program will provide a wonderful opportunity to catch up on these projects—so many of them that space prohibits even listing them here—which are making Pittsburgh one of our great cities.



How would you save a failing sewer in quicksand, 42 feet underground?



Yes, it was a tough question. But Armco Liner Plates provided an easy answer. Here's the chain of events:

In Owensboro, Kentucky, an 84-inch-diameter rigid pipe trunk line, carrying sanitary and storm sewage, began to fail. It had been tunneled through quicksand, and now was developing large cracks that admitted highly fluid sand. To complicate the problem, the sewer was 42 feet underground and any repair had to be made while the sewer was in operation.

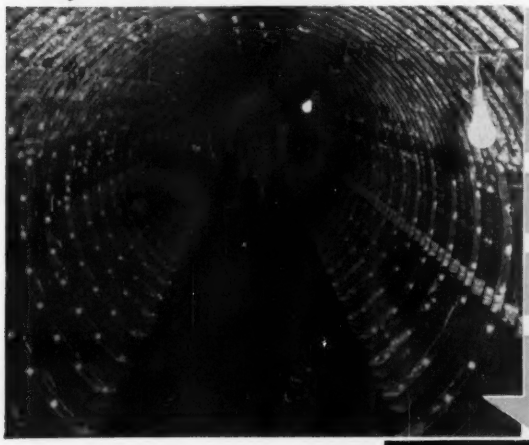
The project was opened to competitive bidding. Armco Liner Plates, combined with the know-how of Armco Construction Service, got the job. The precurved, corrugated metal Armco Liner Plate sections were taken into the failing sewer and bolted together from the inside to make an integral lining structure. No space was wasted. And the offset-lapped joints of Armco Plates provided extra strength.

For this sewer lining job, the Armco Liner Plate structure was 72 inches in diameter. The 10-gage plates were bituminous coated.

For more data on Armco Liner Plates, write us. Armco Drainage & Metal Products, Inc. 5486 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: Write Guelph, Ontario. Export: The Armco International Corporation.

RIGHT: Worker is attaching another Armco Liner Plate. Note water flowing during installation and the absence of waste space between the old and new structures.

BELOW: The completed Armco Liner Plate structure being inspected after a siege of high water. Note perfect alignment and high water marks.



ARMCO ARMCO® **LINER PLATES**

NOTES FROM THE LOCAL SECTIONS

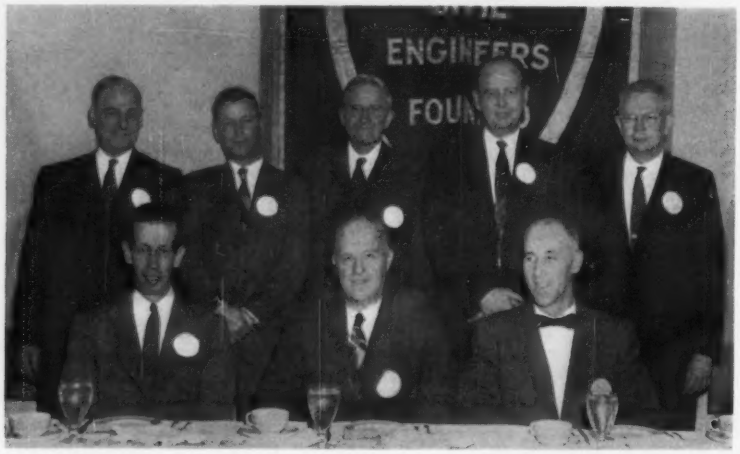
(Copy for these columns must be received by the tenth of the month preceding date of publication.)

Scheduled ASCE Conventions

PITTSBURGH CONVENTION
Pittsburgh, Pa.
William Penn Hotel
October 15–19, 1956

JACKSON CONVENTION
Jackson, Miss.
Hotel Heidelberg
February 18–22, 1957

BUFFALO CONVENTION
Hotel Statler
June 3–7, 1957

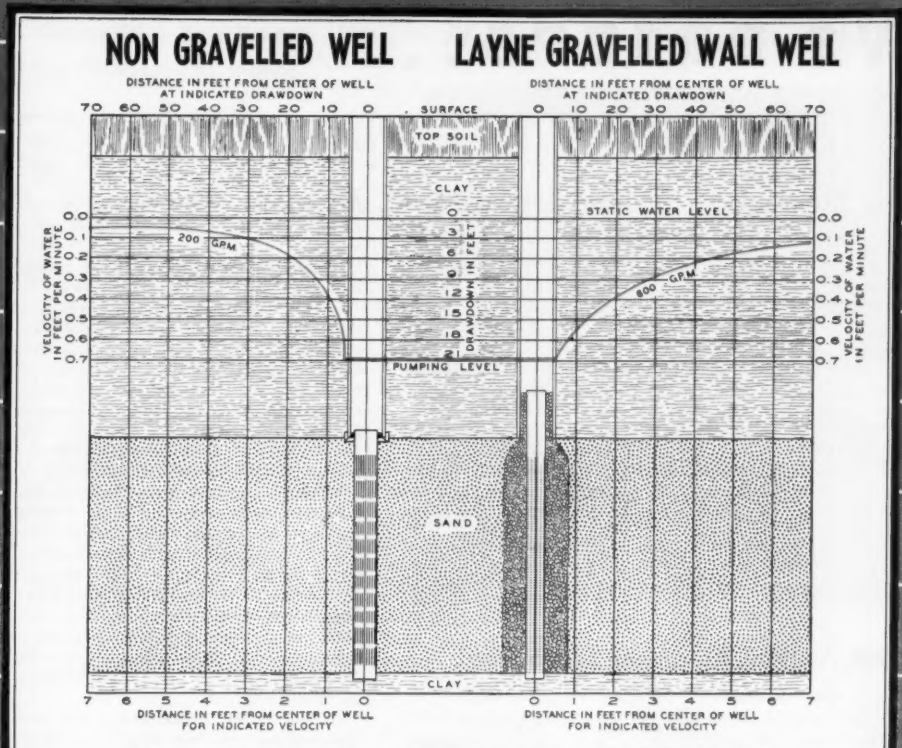


Panel discusses "Mandatory Registration for Engineers in Massachusetts" at joint meeting of Massachusetts (formerly Northeastern) Section and Boston Society of Civil Engineers. In front row, usual order, they are John G. W. Thomas, president, BSCE; Ralph W. Howe, member of BSCE and moderator; and Edward C. Keane, president of Massachusetts Section. Standing are Edward H. Barry, ASME and Massachusetts Board of Registration; Oscar S. Bray and Thomas R. Camp, members of ASCE; Frederick S. Bacon, AIEE; and Charles T. Chave, ASME and AIChE. Massachusetts is considering legislation to change its present permissive law to a mandatory law.

L. G. Feil (left in lower view), president of Kansas City Section, presents award to Benjamin F. Bouser, of University of Missouri Student Chapter, as outstanding civil engineering senior. Chapter members were guests of the Section, and the program featured a talk on rare technical books.

There are presidents galore at Hawaii Section's annual meeting, held at Princess Kaiulani Hotel at Waikiki late in April. In usual order (in left-hand photo) they are Francis Wai, Section president; ASCE President Enoch R. Needles; Rear Admiral Joseph F. Jelley, Jr., president of Society of American Military Engineers; and Tadashi Yoshizawa, president of University of Hawaii Student Chapter. In right-hand view Dick Granger (center), vice-president of Dallas Branch of Texas Section, chats with future engineer Jimmy Verges and Carl Reistle, president of the AIME, at annual "dinner for future engineers" sponsored by Engineers Club of Dallas. Dallas Branch of Section sponsored a number of the 260 high school seniors attending.

GRAPHIC COMPARISON OF RESULTS



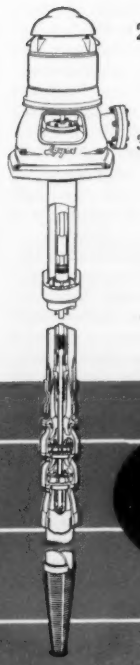
PRODUCTION AND OPERATING CHARACTERISTICS OF TWO TYPES OF WELLS

Above at right is a Layne Underreamed Gravel Wall Well equipped with Layne Shutter Screen. At left is a standard tubular, non-gravelled well with usual metal water well strainer installed in direct contact with the waterbearing sands. Both wells are twelve inches in diameter, finished in the same waterbearing aquifer and equipped with the same diameter and length of screen.

Layne Gravel Wall Wells Designed for Better Service

1. Layne shutter screen is designed specifically for use in gravel wall wells.
2. Selection of gravel and thickness of pack surrounding the screen is determined for the individual well unit after careful study of underground formations.
3. Engineering "know how" plus expert supervision eliminates guess work.

The net result is a ground water supply unit which yields more water with less draw down, consequently, low pumping cost and longer producing life—a unit which pays dividends on original cost.



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Water Wells • Vertical Turbine Pumps • Water Treatment

NEWS BRIEFS . . .

Engineering Education Studied at E. I. C. Annual Meeting

Canada's concern with engineering education and the corollary problem of professional manpower was manifested in a large conference on engineeering education, which ran concurrently with the seventieth annual meeting of the Engineering Institute of Canada, held in Montreal, May 23–25. The deans and heads of engineering faculties of all the engineering-degree-granting universities in Canada attended the conference. The student viewpoint was expressed by undergraduates from the various universities, who met with representatives of the Institute to discuss problems of engineering education. There was also a junior panel discussion on "What Can a Young Engineer Do to Develop Professionally?"

The three-day program—held in association with the American Society of Mechanical Engineers and the American Rocket Society—attracted over 1,000 engineers and their families, the largest attendance in the history of Canadian meetings. C. E. Davies, for many years secretary of the ASME, was one of five engineers inducted into honorary membership at the annual banquet. The others were Albert R. Decary, former superintending engineer of the Quebec Department of Public Works; Francis W. Gray, former assistant general manager of the Dominion Steel and Coal Corp., Sydney, N.S.; James A. McCrory, engineering consultant to the Shawinigan Engineering Company, Montreal; and Harold W. McKiel, vice-president of Mount Allison University, Sackville, N. B.

For its next president the Institute has chosen Vernon A. McKillop, general manager of the London Public Utilities Commission and of the London Railway Commission, London, Ont. He succeeds R. E. Heartz, M. ASCE, president of the Shawinigan Engineering Co., Montreal. New vice-presidents are H. R. Sills, Peterborough, Ont.; G. M. Dick, Sherbrooke, Quebec; and H. W. L. Doane, Halifax, N. S.

A wide range of engineering and professional interests was covered in thirty-two technical papers and two panel discussions. The panel presentations dealt with "Long-range Planning in an Atomic Age" and "Mass Transportation in Cities."

Of special interest were the sessions on electronic computing techniques, which promise to alleviate the manpower shortage by automating the various functions that can just as well be handled by machine. Josef Kates, president of K.C.S. Data Control Limited, Toronto, noted that "The increased engineering productivity which will accompany automation ought to increase the engineer's standard of living, just as rising productivity has increased the living standard of the population in general." In the United States, at present, one engineer is required for every seventy-five production workers. "Our economy," said Mr. Kates, "seems to be headed into a bottleneck, an engineering bottleneck." Automation in this field would be "the application of the engineer's method to his own art."

In another leading talk Duncan McIntyre, senior assistant engineer, hydraulics, St. Lawrence Seaway Authority, emphasized the "large and indispensable part" river models are playing in planning and designing the tremendous project. "In scope and intensity the model study work being carried on in connection with the seaway planning and design is probably unsurpassed in the history of engineering," he said. "The international, interprovincial, and interurban character of the seaway makes it essential that the effects of all development work be predicted accurately and that the best engineering design procedures be used."

The 1957 annual meeting will be at the Banff Springs Hotel, June 10–14.

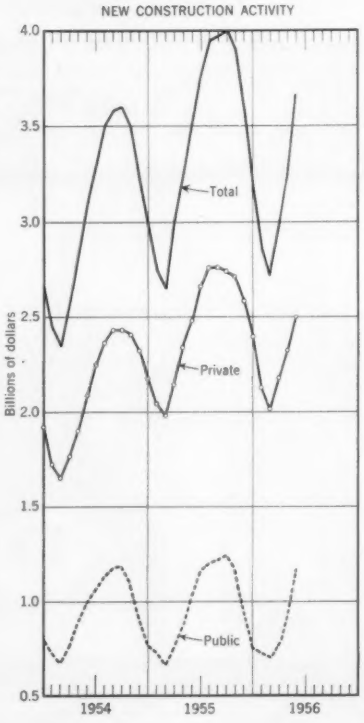
May Construction Activity Advances Seasonally

The value of new construction put in place expanded seasonally in May to $3.7 billion, equalling the previous high for the month set last year and rounding out a record total of nearly $15.8 billion for the first five months of the year, according to preliminary estimates of the departments of Commerce and Labor. After allowance for seasonal changes, construction expenditures during May rose to an annual rate of $43.6 billion. This compares with an annual rate of $43.1 billion established in January 1956 and actual outlays of $43 billion in 1955.

Private expenditures in the January-May 1956 period came to $11.3 billion, equalling the all-time high for private construction outlays reached in the first five months of 1955. A decline of $450 million in private housing was offset by advances of $230 million in private industrial building and $235 million in commercial building.

Public outlays during the five-month period were up 2 percent from the total for the corresponding months in 1955, chiefly as a result of increases in highway construction, sewer and water work, and public service enterprises (principally facilities connected with the St. Lawrence Seaway). A continuation of the decline that began two years ago in the construction of atomic energy facilities resulted in a 57 percent decrease in public industrial construction.

The expansion in May occurred in virtually all types of construction. Private industrial building rose to a new all-time high for the third successive month. New May records were also set by commercial building, educational building (both private and public), public utility construction, sewer and water facilities, highway construction, and public service works.



New construction in May expands seasonally to $3.7 billion, equalling the previous high for the month set in 1955 and comparing with annual rate of $43.1 billion established in January.

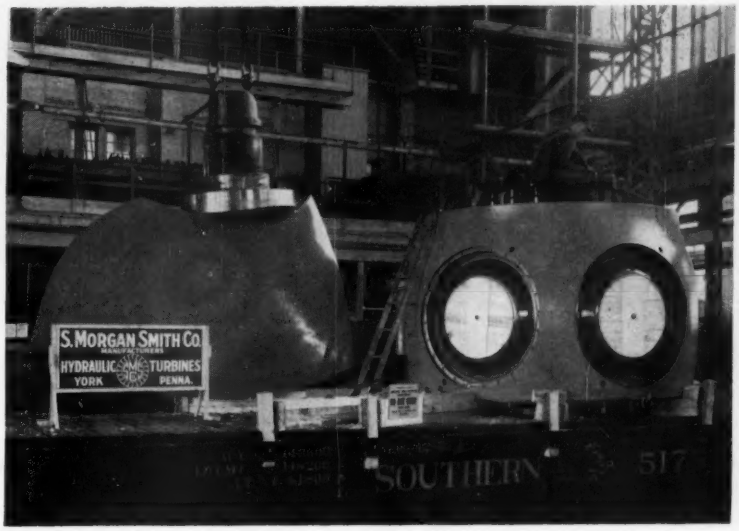
Competitive Bids Taken For Philadelphia Bridge

The City of Philadelphia recently opened bids for the Henry Avenue Bridge over Gorgas Lane—a structure comprising five 120-ft spans and two end spans of about 74 ft each. The design, as prepared by Gannett, Fleming, Corddry and Carpenter, consists of two structural steel plate girders, steel floor beams, and a poured-in-place concrete deck. Of much interest was a provision in the specifications, permitting bidders to submit any other design in any other material provided it met the engineer's requirements—the first time since construction of the Walnut Lane Bridge that competitive bids have been taken on a major bridge structure for both structural steel and other material.

For the three low bids the price differential between steel and prestressed concrete was from 8 to 20 percent cheaper. Low bid of $838,769 for prestressed concrete is based on a design prepared by Preload.

Noel Willis is bridge engineer for the Philadelphia Department of Streets.

Plant Ships Last Turbine for McNary Dam Powerhouse



Last runner of fourteen Smith-Kaplan turbines for McNary Powerhouse is being shipped from the York, Pa., plant of the S. Morgan Smith Co. Here the hub with one of its six blades is being loaded on a railroad car. Contracts from the Corps of Engineers for the first units were signed seven years ago with the S. Morgan Smith Co., which has designed and manufactured all the hydraulic turbines for the $286,000,000 multiple-purpose project. The units are the most powerful Kaplan turbines now in operation with a field test output of 138,000 hp. When the last unit goes on the line this fall, it will bring the total rated hydro capacity installed by Army Engineers up to 4,165,000 kw, of which McNary represents 23.5 percent.

Drought Continues in Southern California

Drought continued unabated in Southern California during 1955, according to a review of water-supply conditions just completed by the Geological Survey. Runoff during the year ending September 30, 1955, was only half that of the preceding year, the report notes, and only slightly more than 25 percent of the average for the 30-year period, 1920–1950. As a result of these continuing dry years, most of the Southern California reservoirs were practically dry (8.7 percent of total capacity) on September 30. The trend in ground-water depletion that started more than twelve years ago continued during the year, with the result that the water levels in the observation wells were the lowest for the period of record.

Because of increasing demands for water, and the length of the current dry spell, the importation of water from Owens Valley and the Colorado River was stepped up from 310,000 acre-ft in 1944 to an all-time high of 732,000 acre-ft in 1955. Almost 125,000 acre-ft of this water was placed in ground-water storage last year in an attempt to retard the decline in ground-water levels and to reduce the threat of sea-water intrusion.

The survey review is part of a report, entitled "Southern California Water Resources Summary for 1955." Copies of the report are available for inspection in any Geological Survey office; Room 2238, General Services Administration Building, Washington, D.C.; and 429 U. S. Post Office and Court House, Los Angeles, Calif.

Tribute Paid to J. F. Stevens for Panama Canal Work

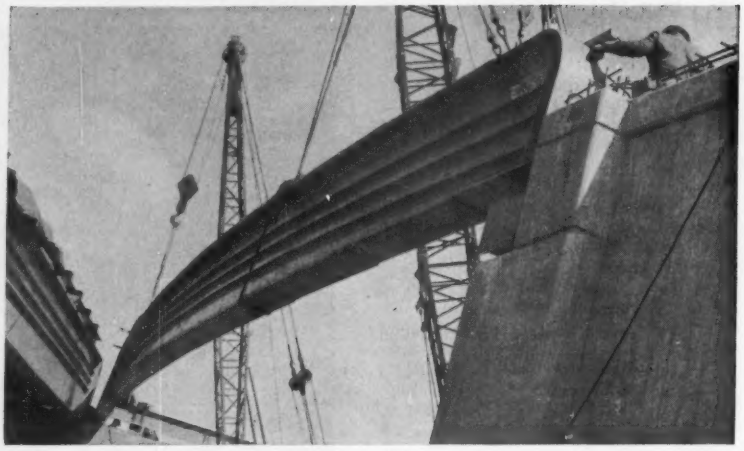
The contribution of John F. Stevens, Past-President and Honorary Member of ASCE, to the building of the Panama Canal was commemorated at a memorial dinner held in Washington, D.C., on May 12. Sponsored by the Panama Canal Society of Washington, D.C., the dinner marked the fiftieth anniversary of the adoption by Congress and the President of a plan for the Canal.

In the featured address, the Hon. Daniel J. Flood, Congressman from Pennsylvania, paid tribute to Mr. Stevens as "basic architect of the Panama Canal." In particular, Mr. Flood gave him principal credit for "the key decision" to build a high-level-lake and lock type of structure rather than a sea-level canal. Though primarily a railroad engineer, Mr. Stevens achieved lasting fame as chief engineer of the Isthmian Canal Commission from 1905 to 1907, the crucial early days of construction. In 1907 President Theodore Roosevelt appointed him chairman of the Commission in addition to his assignment as chief engineer, making him the first man to hold the combined positions.

Said Congressman Flood, "The significance of Stevens' Canal contributions, though substantially obscured for a time, has gained stature with the years. He rescued the project from possible disaster; assembled a major part of the plant and organized the forces for construction; planned the main features of the waterway and brought about the great decision for the high-level-lake and lock plan; launched the enterprise into the era of construction and guided the work until its success was a certainty. Not only that, Stevens clearly foresaw the necessity for major changes in the Pacific lock arrangement, for which he developed a plan but was unable to secure its adoption. Subsequent studies of canal operations have established that this plan would have supplied the best operational canal practicable of economic attainment—striking evidence of the high quality of his insight."

Col. George S. Brady, president of the Panama Canal Society, presided at the dinner, and Maurice H. Thatcher, sole surviving member of the Isthmian Canal Commission, was toastmaster. John F. Stevens, Jr., who, as a young boy, accompanied Mr. Stevens to Panama, responded to the tributes to his distinguished father.

New Missouri River Bridge Features Curved Girders



Two curved girders, each 100 ft long, are unusual feature of approach spans of Broadway Bridge over Missouri River at Kansas City, Mo. The combination welded and riveted girders are on a 650-ft radius, and each girder weighs 25 tons. The girders were designed by Howard, Needles, Tammen & Bergendoff, of Kansas City, fabricated at Ambridge, Pa., plant of American Bridge Co., and erected by John F. Beasely Construction Co., of Muskogee, Okla. The Broadway Bridge will cost $13,000,000, and will be opened to traffic in October.

AEC Contract to Aid Yankee Atomic Project

Under the terms of a contract with the Atomic Energy Commission, the Yankee Atomic Electric Company, of Boston, will receive assistance in the development and operation of a large-scale nuclear power plant, to be established in the township of Rowe, Mass. The contract provides for the company to build and operate a pressurized, light water-cooled and moderated reactor and electric generating equipment capable of producing at least 134,000 kw of electricity for distribution over the systems of the several companies constituting the Yankee Company. Fuel elements will be made of uranium oxide clad in stainless steel.

Construction costs are estimated at $34,500,000, of which $18,500,000 will be for the reactor and associated equipment. These costs will be borne by the company. The AEC will perform up to $1,000,000 of the research and development work, and will underwrite the $4,000,000 research performed in private facilities. Westinghouse Electric Corporation has been designated development and design agent for the project, and the Stone and Webster Corporation will build it.

The contract is the first to be concluded under the AEC's Power Demonstration Reactor Program, which was set up to bring private utility groups into the nuclear power picture and to advance the time when such power will be economically feasible.

Reconstructed Brooklyn Bridge Receives Award

Brooklyn Bridge—designed by John A. Roebling in the days of horse-and-buggy traffic and reconstructed, 1950–1953, with wider roadways for modern highway traffic—has been honored by the American Institute of Steel Construction with a special artistic bridge award. Reconstructed by the city from the plans and design of D. B. Steinman, M. ASCE, New York consultant and bridge authority, the structure was cited as "a preeminent example of the adaptability of the steel bridge" to expanding traffic needs.

This newest tribute to the bridge is recorded on a large stainless steel plaque mounted on the Manhattan tower for lovers of "the Bridge" to see on their strolls across the famous elevated promenade. The tablet was unveiled on May 24, seventy-third anniversary of the opening of the bridge, by F. W. Roebling, 3rd, great-grandson of the original designer.

Pennsylvania and New Jersey Turnpikes Linked

The Delaware River Turnpike Bridge, key link in the connection between the New Jersey and Pennsylvania turnpikes, was opened to traffic on May 25, one month ahead of schedule. In brief ceremonies, the structure was hailed as a "dedication to public service and public convenience." By means of the new turnpike connection, motor traffic is now able to move on express highways, practically without interruption, between Maine and the Ohio-Indiana border. When the Indiana Turnpike is completed next November, superhighway travel will be possible to the outskirts of Chicago.

Constructed in less than two years, the massive bridge is a high level structure, 6,571 ft in length between abutments. The bridge deck, of reinforced concrete slab construction, has a width of $76\frac{1}{2}$ ft from curb to curb, plus 2-ft safety walks on either side, and concrete parapets surmounted by an oval aluminum tube railing. Vertical underclearance is 135 ft. Traffic engineers estimate that almost 10,000 vehicles will use the connection daily in 1957, the first full year of operation.

Consultants on the turnpike bridge were George S. Richardson, of Pittsburgh, and Moran, Proctor Mueser, and Rutledge, of New York.

Bid for Priest Rapids Dam Project Approved

Approval of a $91,878,625 low bid by the Merritt-Chapman & Scott Corp. for construction of Priest Rapids Dam on the Columbia River is announced by the Public Utility District of Grant County, Washington. The new dam will be a flood-control, navigation, and power project at Priest Rapids, 125 miles southeast of Seattle. It will involve construction of an 8,412-ft-long reinforced concrete and earth-fill dam, of which 2,427 ft will be concrete and 5,985 ft earthen embankment. The project will include a 1,142-ft-long reinforced concrete spillway section, containing 22 gates, each 50 ft high and 40 ft wide; a powerhouse 900 ft long and 205 ft wide; upstream migratory fish passages; and provision for a future navigation lock. When completed, it will provide a 22-sq mile reservoir area.

The accepted bid was approximately $1,250,000 lower than the next bid and the only one of the five submitted that was made by a single company. Merritt-Chapman & Scott is currently building Gorge High Dam across the Skagit River, about 100 miles northeast of Seattle, as a municipal power project for the city.

Contract for New AEC Headquarters

The Atomic Energy Commission has awarded John Mc Shain, Inc., of Philadelphia, a contract for construction of its new headquarters building near Germantown, Md., about 23 miles from Washington. The company's bid of $8,828,000 was the lowest of thirteen received. The four-story wing-type structure of monolithic reinforced concrete faced with brick, which will house the entire AEC staff, is scheduled for completion in 1957. Cost of the whole project, including several auxiliary buildings, is scheduled for late 1957.

Westinghouse Active in Atomic Developments

Last year the Westinghouse Electric Corporation earmarked and began spending more than $20,000,000 of its own money for new enterprises in the atomic power equipment field, the company's 1955 annual report reveals.

Other atomic developments, with which the company is connected, include operation of the Bettis plant facilities near Pittsburgh for the Atomic Energy Commission. At this plant progress is being made on the nation's first reactor for a large surface vessel, and also on reactors for fleet-type submarines. Construction of the first full-scale power plant for generation of electricity is making headway at Shippingport, Pa. The company is also making plans to build and equip a nuclear-core-manufacturing facility at Cheswick, Pa., and is cooperating with the Pennsylvania Power and Light Company, of Allentown, in a program to develop an atomic plant generating at least 150,000 kw.

In 1955 Westinghouse became the first American company to market an atomic power plant abroad. It will build the plant for the Syndicat d'Etude de l'Energie Nucleaire of Belgium under the terms of a bilateral agreement between the United States and Belgian governments.

Aid for Engineers Going To International Congress

The National Science Foundation is planning to assist a limited number of engineers and scientists to attend the ninth International Congress of Applied Mechanics, held in Brussels, Belgium, September 5–13, 1956. Applications for these international travel grants should be submitted to the National Science Foundation, Washington 25, D.C., not later than August 1.

Western Public Works Officials Have Annual Meeting

A wide range of public works engineering was covered in the 1956 Western Public Works Conference, held recently in Oakland, Calif. More than 350 public works officials from eleven Western states were attracted by the three-day program, to which the Northern California Chapter of the American Public Works Association was host. Cooperating in the arrangements were the League of California Cities and the Institute of Transportation and Traffic Engineering.

The federal aid highway program received detailed attention in the opening session, which featured a talk by A. C. Clark, deputy commissioner of the U. S. Bureau of Public Roads, Washington, D.C. Raymond Archibald, division engineer for the Bureau of Public Roads, was panel moderator for this program, which produced much interesting information. A panel of city managers and engineers from recent California disaster areas contributed to a timely session on "Functions of Public Works Under Disaster Conditions." M. Justin Herman, regional administrator of the U. S. Housing and Home Finance Agency, was featured speaker.

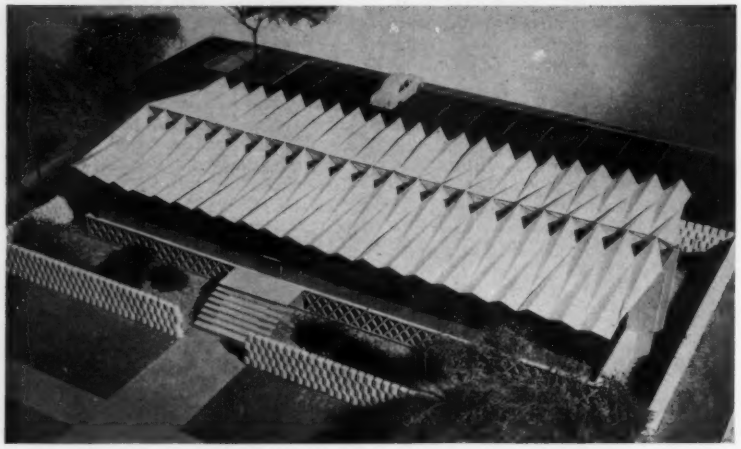
Special interest was shown in a session devoted to the professional manpower problem. Morrough P. O'Brien, dean of engineering at the University of California, gave the key address, entitled "The Future Availability of Professional Engineers." Prof. Harmer E. Davis, director of the Institute of Transportation and Traffic Engineering, moderated a panel discussion that brought out the views of Wayne Snowden, representing the Institute; Richard Gallagher, director of public works for the City of San Diego; W. G. Burris, district manager of Remington Rand; Rear Admiral C. A. Trexel, speaking for the Tudor Engineering Co.; and Scott Lathrop, supervising highway engineer of the California Division of Highways.

Paul Oppermann, director of planning for the City and County of San Francisco, was principal speaker in a program devoted to "Financing Capital Improvements." A panel of experts in the fields of bond financing, assessment districts, and lease purchase of equipment discussed the various phases of the subject. The taxpayer's viewpoint was presented by J. Roy Holland, director of research for the California Taxpayers' Association.

In another important session, devoted to "Planning Public Works," Walter Hahn, city manager of Monterey, emphasized the value of advance planning. The final session—on "Constructing Public Works in the West"—featured a talk on California's public works program by Frank B. Durkee, state director of public works.

Prominent on the conference program were ASCE members (left to right): Kenneth K. King, vice-president, Western Area, APWA; Prof. Harmer E. Davis, director of the I.T.T.E.; John A. Morin, president, Northern California Chapter, APWA; and Lyall A. Pardee, president, Public Works Officers Dept., League of California Cities.

ACI to Have New Headquarters Building in Detroit



Spectacular new home for the American Concrete Institute (shown here in photo of model) appropriately features a folded-plate reinforced concrete roof system. The roof, cantilevered front and rear from concrete interior corridor walls, projects over the exterior walls of precast concrete panels and glass, shielding them from the sun and reducing the air-conditioning load. The shorter end walls are shielded by perforated screens of colored concrete pipe section, laid with the ends exposed to view. Unusual triangular skylights will admit daylight to the central corridor. Construction of the building, which will be located in the northwestern residential area of Detroit, will start early next year. Minoru Yamasaki, noted Japanese architect, is the designer.

Large Aircraft Hangars Reroofed with Aluminum

Massive, parabolic-shaped blimp hangars at the Lakehurst (N.J.) Naval Air Station are being given a new lease on life by the installation of aluminum alloy roofing sheet. The Wigton-Abbott Corp., engineers-constructors of Plainfield, N.J., was retained by the Bureau of Yards and Docks to solve chronic and expensive roofing problems resulting from heavy winds and roof movement. After testing a variety of materials, the company recommended corrugated aluminum sheathing. It was found that the sheathing would stay tight and withstand the racking of the timber framework and hurricanes up to 120 mph. Low-cost maintenance is another advantage. The two structures cover 640,000 sq ft, stand 175 ft high, and have a roof area of nearly 1,000,000 sq ft. Built during World War II, the timber structures are the base for anti-submarine blimp operations in the East.

N * G * Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

"Well, Joe, I suppose you had lots of free evenings at Knoxville, Tenn-AS-CE to fit 6 assorted pills in a pillbox without hiding its center."

"Unnh-uh. Fay Kerr went with me, so there weren't any free evenings, nor any little pills except convention-size aspirins. After I got home I made a nice start, using algebra, but haven't finished yet."

"Well, if it's nice, let's see it."

"O K, Professor Neare. You gave us the formula for negative curvature of the circle circumscribed about a cluster of 3 circles, all letters representing curvature, or reciprocals of radii:

$$h = e + f + g - 2\sqrt{ef + fg + ge} \quad . . .(1)$$

"For this problem e, f, and g are different integers and all greater than $-2h$ to expose the center of the outer circle. So I let $e = -2h + 1$, $f = -2h + 2$, and $g = -2h + 3$, which reduced (1) to

$$h^2 + 12h - 8 = 0. \quad . . .(2)$$

"This can't be solved in integers, but obviously all I have to do is vary the differences 1, 2 and 3 until the resulting quadratic can be factored."

"Looks like the convention did Joe some good," conceded Cal Klater. "I found an

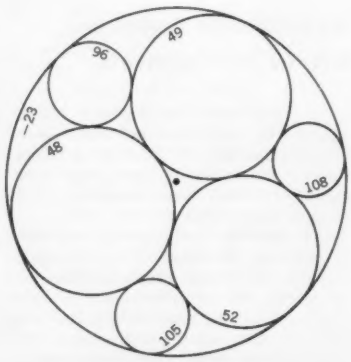


Fig. 1. Random pills in pill-box form pattern of 7 commensurable curvatures

easier way, but its harder to explain, so using Joe's scheme in a general way with

$e = -2h + x$, $f = -2h + y$ and $g = -2h + z$, I reduced (1) to

$$-h = x + y + z \, 2\sqrt{xy + yz + zx}. \quad (3)$$

"Hence for any rational set (e, f, g, h), which may cover the center spot, there is a solution (e', f', g', h') with $h' = h - 2(e + f + g)$ and $e' - e = f' - f = g' - g = -2h'$. Simplest is the primitive set (2, 3, 6, −1) which generates the solution (48, 49, 52, −23). That's my answer, and I admit Joe would have found it on the 15th trial."

"Fair enuf," agreed the Professor. "There are, of course, an infinite number of solutions, since each generates a new one by repetition of the same formulas. Yours uses the smallest numbers, the next being (71, 74, 75, −34) derived from the primitive set (3, 6, 7, −2). Now that you're gaining on them, Joe, do you want another sequel?"

"Not for awhile, thanks. You've had me running around in circles for four months now, like a big wheel in a federal bureau."

"Then I'll let you practice some more algebra on spilled milk. The Half-and-Half Department of a creamery, which does not want to be identified for obvious reasons, uses two identical tanks—an upper one half full of cream which discharges into the lower one half full of milk, after which the lower one discharges the blended mixture into the forebay of the bottling machine.

"By mistake, one day, the two identical tank orifices were opened at the same time. If the upper tank emptied in an hour, when did the lower tank discharge half-and-half?"

[Ad L. Pate (G. H. Wilsey) was the only Cal Klater who stayed home from Knoxville to play with pills in a pillbox.]

Navy Builds Large Air Base on Mississippi Delta

Tandem pushers are used to advantage in sand-loading operation on Mississippi delta air base project. Contractors' studies indicate double-heading cuts scraper load job. Pushing is handled by a pair of Tournatractors and two D-8 crawlers in similar tandem.

South of New Orleans on the Mississippi River delta, the Navy Civil Engineer Corps is building a huge new $50,000,000 air base in the heart of a cypress swamp, reputedly too soft to support heavy construction equipment. This new Alvin Callender Joint Air Reserve Training Center, which is being jointly financed by the three Services, will cover a 3,000-acre area of swamp and heavily wooded terrain ranging in elevation from 5 ft above to 4 ft below sea level.

With their first contract—an 8,000-ft runway-taxiway system—already completed and a similar one under way, joint venturers Blythe Brothers, Inc., and Morrison-Knudsen Co., Inc., are using the same general methods on the present contract. Briefly, the construction procedure is as follows: After draining excess moisture from the section, through a canal constructed for the purpose, unstable organic matter is stripped off the entire section to be paved. A blanket of sand is then laid to provide a suitable sub-base for surfacing. Thickness of the blanket is sufficient to raise the grade and assure adequate drainage. The final step before paving is application of a "surcharge" to accelerate settlement of the sand to assure stability in the finished runway.

As the first step in preparing for the entry of their heavy equipment, the contractors cut a system of canals through the swamp to drain off excess moisture. When the area had sufficiently dried to support equipment, bulldozers with long horn-shaped spikes on their blades were brought in to clear the wooded sections. After the trees had been cut and windrowed, they were saturated with oil and burned.

A deposit of suitable sand was discovered at the bottom of the Mississippi River channel about a mile from the construction site. To deliver it, a 3,500-hp dredge was located on the river and the sand pumped up to the pile through 27-in. pipe. Since July 1954 when the original contract was started, the deposit has provided more than 2,000,000 cu yd of sand

Multi-Purpose Machine Aids Difficult Road-Building Job

Construction of this three-fifth-mile stretch of Topanga Canon Blvd. at the west end of San Fernando Valley proved a contractor's nightmare. In a distance of 200 ft the job changed from a 100-ft fill to a cut of 160 ft. It was also required to keep traffic moving during specified hours, and night work was necessary to complete the work within the time set. Here the contractor—Lowe & Watson, of San Bernardino, Calif.—is using a multi-purpose Gradall in a spot where the machine practically stands on its head to remove the earth. An 18-ft extension boom gave the unit the necessary reach for the job, and a ripper tooth was used to remove rocks from the slope.

DECEASED

John Berg (M. '25), age 86, retired civil engineer of Pierre, S.D., died in Santa Monica, Calif., recently. A graduate of the University of South Dakota, class of 1895, Mr. Berg received his Ph.M. there five years later and his civil engineering degree from the University of Wisconsin in 1905. He had been assistant engineer for the Glyndon Construction Co., of New York City, working on adjustment of the Manhattan Bridge cables suspended superstructure, and for the Ralph Modjeski firm on the design of numerous long-span bridges. From 1919 to 1929 and from 1931 to 1933 he was state engineer of South Dakota in charge of state building construction. He had also taught mathematics and civil engineering at the University of South Dakota and Iowa State College.

John Berg

Edward R. Bowen (M. '20), age 71, one-time partner in the engineering firm of Lippincott & Bowen, Los Angeles, Calif., died at his home in Pasadena, recently. Mr. Bowen was known for his work on water supply projects from San Francisco to the Mexican border. He was one of the consulting engineers who designed many of the principal structures of the Los Angeles Aqueduct. A major in World War I, Mr. Bowen played a prominent part in the design and construction of Camp Kearney, North Island, Fort Rosecrans and Fort MacArthur. In World War II he was with the U. S. Army Engineers in Los Angeles. Long prominent in the Los Angeles Section, he served as president in 1941.

William P. Butler (M. '21), age 69, of Annapolis, Md., died at Rocky Mount, N.C., on May 6. Prominent in highway engineering for more than forty years, Mr. Butler had at various times been division engineer with the State Highway Departments of Washington, Oregon, Tennessee, and Alabama, and for four years was district engineer for the U. S. Bureau of Public Roads at Harrisburg, Pa. He was a graduate of the U. S. Naval Academy, class of 1909, and a Navy veteran of both World Wars, retiring from the service with the rank of lieutenant commander.

Harry Cady Byrnes (M. '22), age 72, retired civil engineer of El Monte, Calif., died recently. Mr. Byrnes had been with the J. G. White Construction Co. in California, Chile, and Panama, and for a number of years prior to his retirement in 1943 was in the New England Division of the Corps of Engineers. He was a veteran of World War I and a long-time reserve officer in the Corps of Engineers. He was educated at the University of Kansas.

Chesley A. Chipley (A. M. '37), age 51, for the past six years vice-president of the Fordyce Grave Company of San Antonio, Tex., died at his home there recently. A graduate of Texas Agricultural and Mechanical College, class of 1926, Mr. Chipley began his career with Walton and Arneson, consulting engineers of San Antonio. In 1932 he joined the Texas State Highway Department, serving for seven years as resident engineer and senior resident engineer. From 1939 to 1950 he was general superintendent for R. W. Briggs and Company of San Antonio, estimating for bid preparation for construction of various projects, including Camp Berkeley at Abilene, and the Naval Air Station at Corpus Christi, Tex.

George Conrad Diehl (M. '10), age 83, president of George C. Diehl, Inc., civil engineering consulting firm of New York City, died at his home in that city on May 26. Following his graduation from Rensselaer Polytechnic Institute in 1894, Mr. Diehl entered the State Engineering Department at Albany, where he was in charge of canal and highway improvements. From 1898 until 1934, when he retired from public service, he was county engineer and superintendent of highways for Erie County, New York. During his tenure with Erie County more than 2,600 miles of improved roads were built. A former president of the American Automobile Association and a founder and former president of the Automobile Old Timers, Mr. Diehl played a leading role in highway development in this country.

M. L. Enger, Former ASCE Director, Dies

Melvin L. Enger (M. '21), age 75, retired dean of the College of Engineering, at the University of Illinois, died at his home at Escondido, Calif., on May 12. A graduate of the University of Illinois, class of 1906, he later received several graduate degrees there, and in 1907 began a 42-year teaching career at his alma mater. In 1926 he became head of the Department of Theoretical and Applied Mechanics, and from 1934 until his retirement in 1949 he was dean of the Engineering College and director of the Engineering Experiment Station. During his long tenure with the university as teacher and administrator, its physical plant was tremendously expanded. A Director of ASCE from 1932 to 1934, Dean Enger was prominent in the Hydraulics Division. He was also author of many technical papers on hydraulics.

Dean Enger

DeForest H. Dixon (A.M. '04), age 83, retired vice-president and director of the Turner Construction Company, died at his home at Great Neck, N.Y., on May 5. A graduate of Cornell University, class of 1896, Mr. Dixon was active in concrete dam and water works service in New York and Pennsylvania and was the engineer on the rock tunnel section of the subway under Fourth Avenue, New York City. In May 1902 he became associated with H. C. Turner, and together they founded the Turner Construction Company, with Mr. Dixon as director, general superintendent, and secretary. In 1910, he was elected vice president. He retired from active service in the company in 1930, but remained a director until his resignation in May 1949.

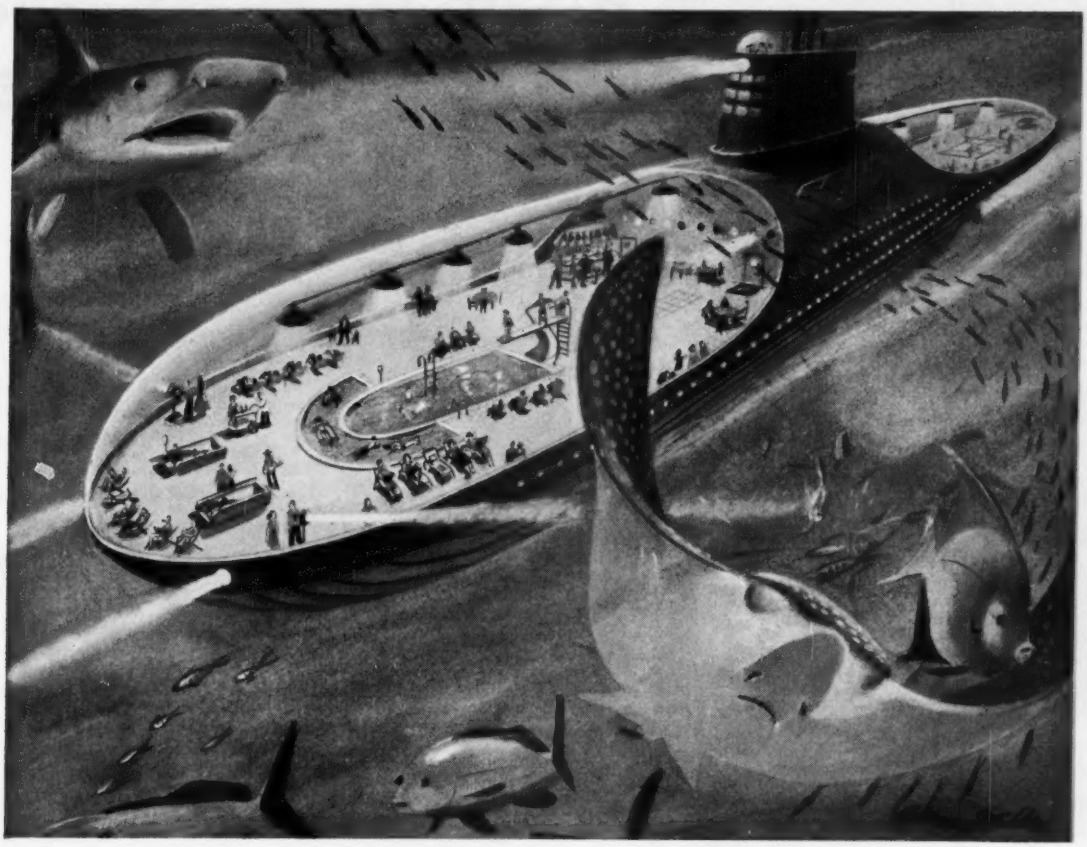
Leon Fleischmann (A.M. '16), age 77, prominent engineer and banking executive, died at his home in New York City on April 17. Mr. Fleischmann built the U. S. naval torpedo station at Alexandria, Va.; the 71st Regiment Armory in New York City; and the Famous Players-Lasky motion picture studios in Long Island City. He helped to draw up the New York City building code and was a consultant on the rewriting of the state's fire insurance laws. A founder of the Ninth Federal Savings and Loan Association of New York City, he was chief appraiser and engineer from 1935 to 1941 when he became president. Mr. Fleischmann retired as president in 1953.

Dimitry Benjamin Gumensky (M. '48), age 58, died at his home in Berkeley, Calif., on May 21. A graduate of the University of California, Mr. Gumensky specialized in structural and hydraulic design. During construction of the Metropolitan Water District of Southern California he supervised design of the aqueduct structures. Later he served as consultant to the U. S. Engineer Department at Sacramento, Calif., built hydroelectric works in China for the Chinese government, and spent several years in Jerusalem laying out an irrigation system for the Israeli government. Recently he had engaged in consulting work in this country.

Clifford Lewis, Jr. (A.M. '02), age 85, retired civil engineer of Philadelphia, Pa. died at his home there on May 8. Mr. Lewis had been in private practice in Utica, N.Y., for many years, specializing in structural work, water supply, and municipal engineering. He served as Commissioner of Public Works of Utica and as county engineer of Oneida County, New York. Moving to Philadelphia in 1928, Mr. Lewis was in private practice until 1938 when he joined the Mutual Assurance Company. He retired in 1946 as treasurer. He was a graduate of the University of Pennsylvania, class of 1892.

William Lowe Lowe-Brown (M. '07), age 80, consulting engineer and specialist

(*Continued on page 94*)



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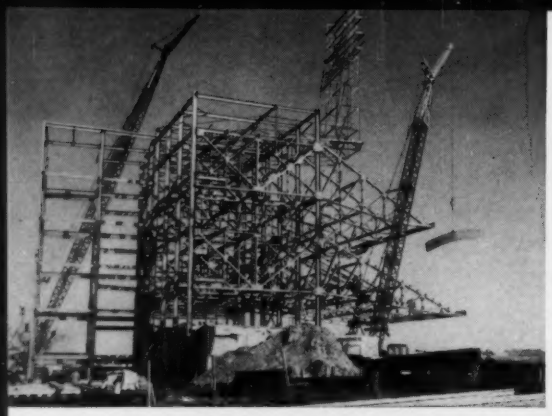


STRUCTURAL STEEL FRAMEWORK under construction, February 27, 1956. Erection of the 1,555 tons of Structural Steel was under the supervision of American Bridge Division of United States Steel.

Cantilever Construction makes every

CLOSE-UP of post-free grandstand showing Structural Steel supporting members for cantilever overhang. Notice large sections of steel decking.

USS STRUCTURAL

with Structural Steel

seat a good seat

in this new Minneapolis stadium

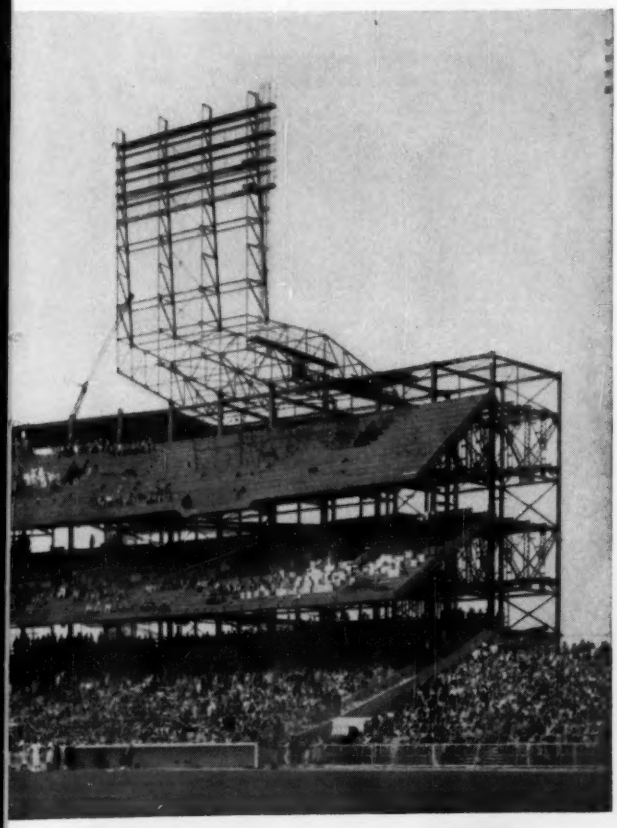
The Metropolitan Sports Area Stadium in Bloomington, Minnesota, just outside Minneapolis, is the fabulous new home of the Minneapolis Millers. Claimed to be the finest baseball stadium in existence, it is actually a Major League size park, although used by a Minor League club. The stadium backers, however, hope that it will house a Major League team in the not-too-distant future.

Remarkably enough, not one dollar of public tax money was used to build this $4,500,000 stadium. It was completely financed through the sale of revenue bonds to more than 2,500 Upper Midwest baseball fans!

Approximately 1,555 tons of Structural Steel were used in the framing of the 30,000-seat stadium. And every seat's a good one, since the cantilevered tiers keep the viewing area entirely post-free. The lower tier is concrete. The upper tiers, roof, exterior ramps, decks, and elevator shafts are of steel. Erection was accomplished with welding and high tensile bolts.

Here is an application which called for a construction material of tremendous load-bearing capacity, great versatility, and honest-to-goodness economy. What other material could possibly have been chosen? Structural Steel is certainly the strongest of load-bearing construction materials, yet the most economical. It can take more abuse than other structural materials, successfully resisting torsion, tension, compression and shear. Enclose it in buildings and it lasts indefinitely—requiring no maintenance. And, of course, it may be welded, bolted, or riveted—erected in any weather. Steel members are fabricated indoors, too, where weather can have no effect on the quality of workmanship. Return the coupon for further information.

OPENING DAY at Metropolitan Sports Area Stadium. *Architect & Engineers:* Thorshov & Cerny, Inc., Minneapolis, Minn., and Toltz, King, Duvall, Anderson & Associates, St. Paul, Minn. *General Contractor:* Johnson, Drake & Piper, Inc., Minneapolis, Minn.



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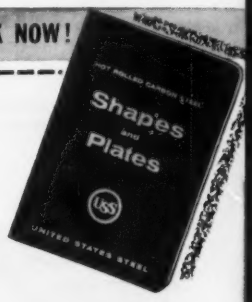

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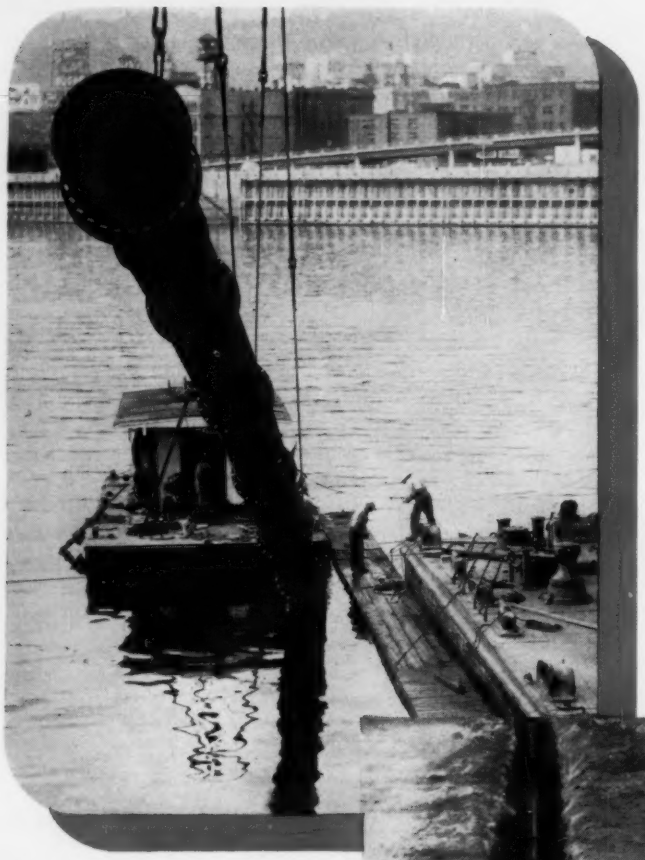
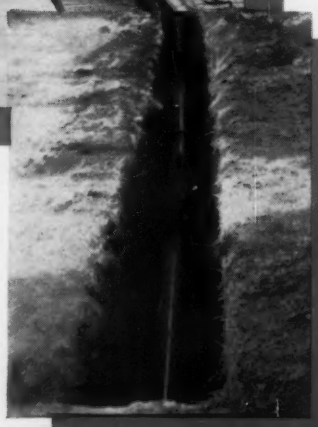


River crossing of cast iron pipe line to carry sewage to disposal plant at Portland, Oregon.



Installation of mechanical joint cast iron pipe for gas distribution at Syracuse, Nebraska.

Cast Iron pipe has long been recognized throughout the engineering profession as a rugged and adaptable material with proved ability to survive beam, compressive and shock stresses. Today's *modernized* cast iron pipe—centrifugally cast—is even tougher, stronger and more uniform in quality. Its effective resistance to corrosion, plus high strength factors, ensure long life with minimum maintenance cost. Yes, you play safe when you lay cast iron pipe—from your own standpoint and that of the taxpayers you serve. For further information, write Cast Iron Pipe Research Association, Thomas F. Wolfe, Managing Director, 122 So. Michigan Avenue, Chicago 3, Illinois.

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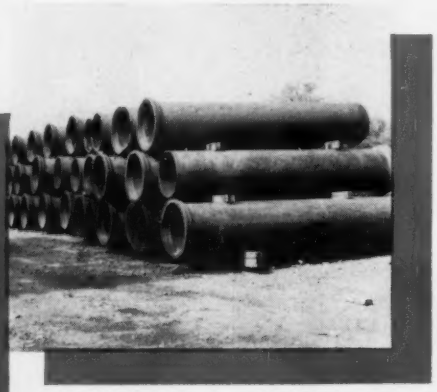
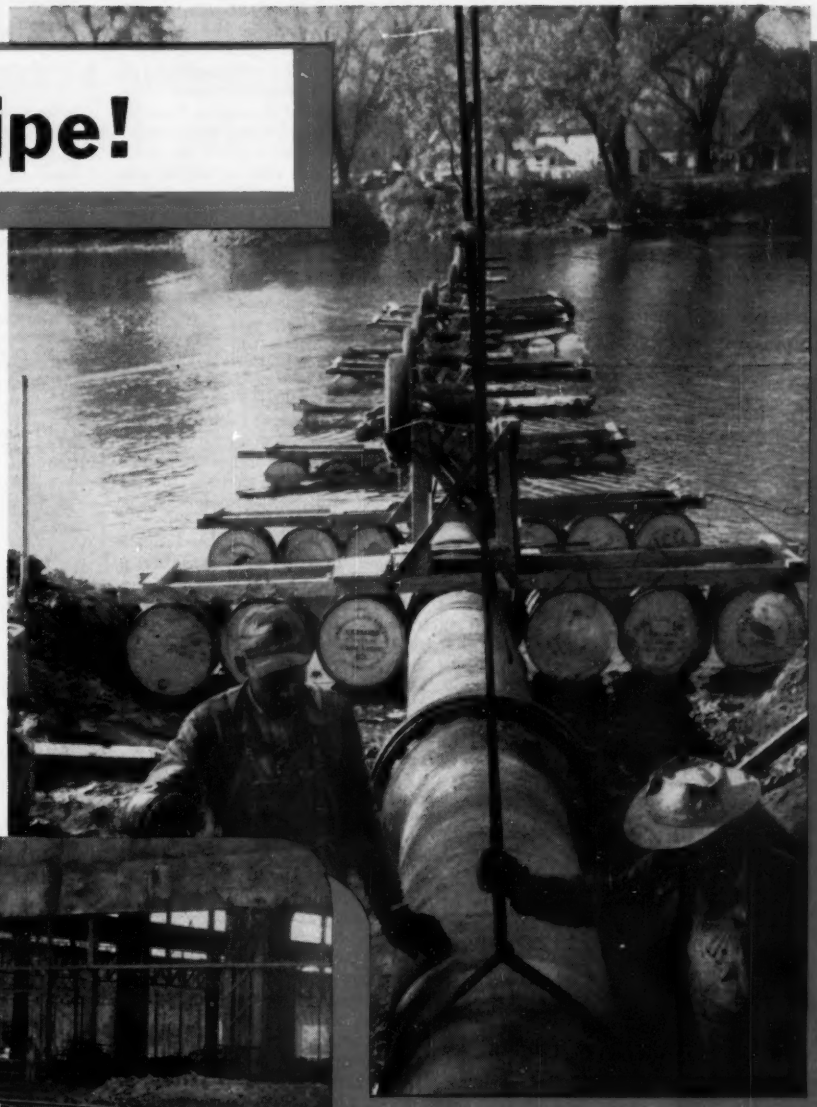


About a half-mile of 49-year-old 24" cast iron pipe dug up, cleaned and re-laid by Cincinnati, Ohio, Water Department.

CAST IRON PIPE

this pipe!



Flexible joint cast iron pipe being installed across Cedar River at Cedar Rapids, Iowa.

Cast iron pipe for large automobile assembly plant in New Jersey.

SERVES FOR CENTURIES...

Deceased

(*Continued from page 88*)

in the construction of tunnels, railways and dams, died at his home in London, England, on March 20. A civil engineering graduate of Liverpool University, Mr. Lowe-Brown was assistant engineer on the construction of the Central London Railroad and the Aswan Dam and Asyut Barrage in Egypt. In 1905 he joined the Pennsylvania Tunnel & Terminal Railroad Co. as resident engineer on construction of the Pennsylvania tunnels under the Hudson River. From 1909 to 1924 he was associated with Buenos Aires Western Railways as engineer and, later, assistant general manager. He served as lieutenant colonel in the Royal Engineers in World War I. From 1929 until his retirement Mr. Lowe-Brown was in private practice, and acted as technical adviser to the British North Borneo State Railways.

Hibbard A. Paine (M. '03), age 87, retired civil engineer and railroad builder, died at his home at Odessa, N.Y., on April 30. Educated in Odessa, Mr. Paine began his career with the Lehigh Valley Railroad in 1891, and for the next 41 years worked for railroad interests all over the United States, Canada, Puerto Rico, Santa Domingo, Haiti, and Panama. He was a location expert, mapping out rights of way and planning roadbeds through uncharted areas. From 1915 to 1931 he was associated with the New York Central Railroad on cost valuations in Buffalo and as a representative of the railroad before the Bureau of Valuation. In recent years Mr. Paine served the U. S. Government on the acquisition of lands and forests and on stream improvements.

Martin Collins Polk (M. '42), age 83, retired consulting engineer and former city engineer of Chico, Calif., died at his home there recently. Mr. Polk studied engineering at Stanford University. For many years he was county surveyor, road engineer, and assessor of Butte County, California. He had also been city engineer of Chico. Mr. Polk carried on a private engineering practice during this time, specializing in the construction of dams and sewage and irrigation systems. He was a member of the Reclamation Board of California on flood control in the Sacramento and San Joaquin rivers.

Edward Nathan Prouty (A.M. '04), age 88, associate engineer with the Clyde C. Kennedy municipal and sanitary engineering firm of San Francisco, Calif., died at his home at Berkeley, Calif., on May 21. A specialist on water supply, sewer, and paving, Mr. Prouty had been connected with the firm since 1920. Prior to that connection he was city engineer of Berkeley for four years. Mr. Prouty was a graduate of Tabor College in Iowa and did graduate work at the University of California. In his early career he taught at UCLA and worked on railroad location and construction for several lines.

Lloyd McCreight Ross (M. '53), age 67, for the past seven years with the Charlotte Lumber & Mfg. Co., Charlotte, N.C., died at his home there on March 29. A graduate of the University of North Carolina, Mr. Ross was with Gaston County, North Carolina, from 1919 to 1931 as highway engineer and chief engineer on many road projects. From 1931 to 1935 he was with the State Highway Commission at Charlotte, and from the latter year to 1949 he served as city engineer of Charlotte. He had also been city engineer of Gastonia.

Thomas Russel Simpson (M. '49), age 60, consulting engineer of Oakland, Calif., and outstanding authority on the water resources of the State of California, died there recently. He had served with the State Division of Water Resources and its predecessors from 1920 to 1950, leaving his position as principal hydraulic engineer in charge of state-wide water investigation in the latter year to accept an appointment as professor of irrigation engineering at the University of California in Berkeley. His contributions to the field of groundwater hydrology have received national recognition. Mr. Simpson received his degree in civil engineering from the University of California in 1920. He was a veteran of World War I,

Thomas Smithson (M. '50), age 45, consulting engineer of Beaverton, Oreg., died at his home there recently. A graduate of the University of California, class of 1935, Mr. Smithson was designing and resident engineer on many sewage treatment plants in Portland, Oreg., and Spokane, Wash. For several years he was a partner in the consulting civil engineering firm of Smithson and Gilbert, specializing in sewage systems and treatment plant and water works improvements. Mr. Smithson had been in private practice since 1948, and was in charge of the design and construction of all utilities for the Cedar Hills Development in Portland. He was a veteran of World War II.

William L. Waters (M. '18), age 79, retired civil engineer of White Plains, N.Y., died there recently. A native of England, Mr. Waters received civil engineering and master of engineering degrees from the Central Technical College of London University. Coming to the United States in 1901, he was chief engineer for the National Brake and Electric Company of Milwaukee, and consulting engineer for the Westinghouse Air Brake, Canadian Westinghouse, and the Westinghouse Electric and Manufacturing Company of Pittsburgh. In 1913 he established a consulting practice, with offices in New York and Montreal, and later became a partner in the consulting firm of Bury & Waters of New York and London. Mr. Waters retired twenty years ago.

New Publications

Saline water conversion . . . Increasing indication of shortages of fresh water throughout the United States as well as in other parts of the world emphasizes the importance of studies of saline water conversion, such as a recent report on the activities of the Office of Saline Water, issued as the 1955 Annual Report of the Secretary of the Interior. Researches to date, according to the detailed report, indicate gradual progress toward low-cost production of potable supplies from saline sources. The report emphasizes that the problem is essentially one of reducing the cost of the water produced, whether accomplished by new processes or by improvement of existing processes. Inquiries concerning the publication should be sent to David S. Jenkins, A.M. ASCE, Director, Office of Saline Water, Department of the Interior, Washington, D.C.

Aerial surveying . . . Mapping by aerial photography and photogrammetry and the equipment used in the work is explained and illustrated in a new eight-page brochure, "Serving the Engineering Profession." Copies may be obtained from Abrams Aerial Survey Corporation, Lansing 11, Mich.

Aluminum building products . . . Release of five new booklets offering up-to-the-minute information on aluminum architectural and industrial building products is announced by the Aluminum Company of America. The illustrated booklets are entitled "Wall Systems of Alcoa Aluminum," "Aluminum in Architecture," "Aluminum Products for Industrial Construction," "Aluminum Roofing and Siding Products," and "Aluminum Industrial Building Products." Copies are available from Alcoa sales offices or Room 773, Alcoa Building, Pittsburgh 19, Pa.

Water pollution control . . . A survey of present-day practices in waste-water reclamation and utilization—conducted by the Engineering Center of the University of Southern California for the California State Water Pollution Control Board—has been issued as State Board Publication No. 12. A limited number of copies are available upon request to the State Water Pollution Control Board, Room 610, 721 Capitol Avenue, Sacramento 14, Calif. Also available without charge from the same source are single copies of a recent revised edition of the "Digest of Sewerage Enabling Acts of the State of California," originally published in 1951. Additional copies may be purchased from the Documents Section, State Printing Division, 7th and Richards Blvd., Sacramento 14, at 50 cents a copy, $4 for ten copies, or $7 for twenty copies.

Engineering employment . . . Publication of a monthly bulletin, entitled "Engineering Employment Practices Newsletter," is announced by the National Society of Professional Engineers. The bulletin is directed to engineering and other industrial executives. Inquiries should be sent to the NSPE, 2029 K. Street, N.W., Washington 6, D.C.

Nuclear engineering . . . Papers and abstracts from the Conference on "The Place of the Atom in Your Business"—sponsored by the Cleveland Engineering Society in December in conjunction with the Nuclear Congress—may be obtained from the Cleveland Engineering Society, 2136 East 19th Street, Cleveland 15, Ohio. The special "Atoms in Your Business" issue of the Cleveland Engineering Society's magazine may be ordered at $1 a copy.

Welding . . . Simplified welding procedures for every base metal are set forth in a 140-page pocket-size Data Book (TIS 2575) announced by the Eutectic Welding Alloys Corporation. The book covers 120 welding rods, electrodes, and welding compounds. Free copies are available from Technical Information Service, Eutectic Welding Alloys Corporation, 40-40 172nd Street, Flushing 58, N.Y.

New York State Engineers build road in spite of slashed budget. Bitumuls with local aggregate is selected.

WHEN a drastic cut in appropriations forced the New York State Department of Public Works to reduce a project to a minimum expenditure, they turned to the proved method of Bitumuls-Native Aggregate construction. Based on the experience of several of the counties in the region, they knew this to be a sound method of stretching road-building dollars.

Rotary mixer and Bitumuls tank truck work in tandem to stabilize 4" lift of base aggregate.

The original plan

Airport construction at Riverhead, Long Island forced the relocation of the Wading River-Manor Road. As engineered by the State Department of Public Works, plans for this road originally called for two 24 ft. lanes for a length of approximately 6 miles. Financing, through the U.S. Bureau of Public Roads, struck a snag; and drastic economies were required to keep the job alive. In adjusting to the lower appropriation, it was decided to reduce the project to one 24 ft. lane, of a length allowable under the available monies.

New estimates indicated this would amount to approximately 3.16 miles, and invitations based on this distance were put out for bids. These specifications called for an 8 inch stabilized base, with 1" Asphaltic Concrete surfacing.

Job data

Local selected soil, sand, and gravel blended to meet the following dry sieve specifications were used for the stabilized base work on this job.

PERCENT BY WEIGHT PASSING		
Sieve	Specification	Aggregate Used
1 ½" Sieve	100	100
1" Sieve	90-100	84.5
¾" Sieve	60-80	78.3
¼" Sieve	30-50	64.2
#10 Mesh	20-40	50.5
#40 Mesh	10-30	10.9
#80 Mesh	7-8	5.6
#200 Mesh	5-15	3.8
Emulsified Asphalt	5-7%	5.75%

The amount passing the 200 mesh was specified to be not more than one-half the amount passing the 40 mesh sieve.

Aggregate was blended at the pit, approximately five miles from the job site, tested, then trucked to, and spread on, the sub-base. Enough such material for the bottom four inches of the base course was brought in and spread. Bitumuls Emulsified Asphalt, mixing grade, was pumped directly from the transport truck into a Rotary type mixer. This first 4" base course was mixed, rolled, and cured. Aggregate was then brought in for the second 4" course and the process repeated.

Heavy rains encountered

During the construction of the base course, two separate hurricanes interrupted job-progress. Delay was held to a minimum because Bitumuls readily coats damp aggregate, and damage caused by the storm was restricted to exposed areas of the sub-base plus those areas of the stabilized base that were not cured.

Surface course construction

The 8" Bitumuls Stabilized Base was topped with 1" fine aggregate Asphaltic Concrete surface course. Spreading and compaction of this material was accomplished by conventional methods. The surface course was extended 1 ft. on either side of the 24 ft. pavement to provide a degree of shoulder stability. Upon final acceptance, the road was turned over to the town of Riverhead, New York, by the contractor.

Sound paving, with economy... Bitumuls Emulsified Asphalt used with local aggregate

ROAD-BUILDERS throughout the nation have come to recognize the value of Bitumuls® Emulsified Asphalt in holding the cost of road construction to the lowest possible level.

A major factor in this economy: *Bitumuls' compatibility with local or in-place aggregates, even though they be hydrophilic.* This eliminates costly transportation of imported materials.

Our Engineers, operating out of our nationwide network of offices, will gladly provide complete information on specific grades of Bitumuls for various types of pavement construction.

Bitumuls is used extensively for maintenance work, too. *Call our nearest office for complete details.*

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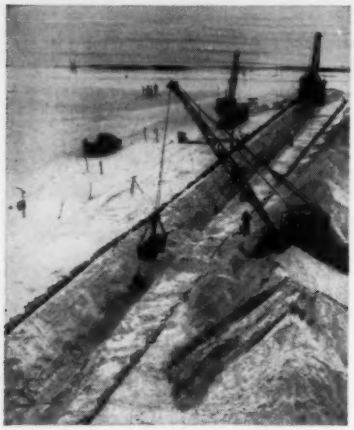

265 FT LAID IN TWO 6-HR
PERIODS BETWEEN TIDES

THIS ENTIRE AREA was under water at high tide—yet wellpoints solved the problem. Using a Griffin Wellpoint system (see photo), contractor dewatered and dug the 265 ft trench, and laid twin transite lines . . . completing all these operations within two 6-hour periods between tides.

• Have *you* a "water worry" coming up? No matter what type job . . . sewer . . . power house . . . dam . . . remember this: The faster you lower water, the more you lower costs. For "quick dry" . . . specify . . . Griffin—wellpoint pioneer and problem-solver through nearly two decades.

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Kraft paper plants . . .

(This article begins on page 56)

(*Continued from page 60*)

Major items of equipment for a power-plant installation for a 650-ton per day mill producing normal-yield pulp are:

Two black-liquor recovery boilers with steam generating capacity of 127,000 lb per hr each; one bark boiler with steam generating capacity of 150,000 lb per hr; two combined fuel boilers, with steam generating capacity of 150,000 lb per hr each; one turbine with generating capacity of 7,500 kw at 0.8 power factor; two turbines with generating capacity of 5,000 kw at 0.8 power factor; one desuperheating station to deliver a maximum of 200,000 lb of steam per hr from 850 to 150 psi for makeup of any 150-psi steam deficiency; one desuperheating station to deliver a maximum of 250,000 lb of steam per hr from 150 to 50 psi for makeup of any 50-psi steam deficiency; one boiler feedwater treatment system with a capacity of 350,000 lb per hr; one paper-machine turbine drive, rated at 3,000 hp, exhausting to the 150-psi system.

Water, vital raw material

Water is probably the second most important raw material for paper manufacturing. It is primarily used for the generation of steam and electric power for the preparation of the cooking liquor, for the cooking of the wood chips, for pulp washing and refining, and for evaporation and recovery of waste liquor. Finally, and probably the most important phase of paper making, it is required in tremendous quantities to convey the pulp between operations and to form a sheet of paper at the wire section of the paper machine.

In 1925, the water requirements for an unbleached kraft mill were conservatively estimated at 110,000 gal per ton of paper. In 1936, when the mills commenced to increase their capacity with the same water supply, the treated water requirements were reduced to about 30,000 to 35,000 gal per ton, through the reuse of the process or "white water." Today, modern mills require about 20,000 to 22,000 gal of treated water per ton of paper, through continued reuse of process water. There are limitations to the amount of reuse which can be practiced since the quality of the water deteriorates to the point where it is no longer suitable for use. The approximate treated-water requirements for a modern kraft mill, in gal per ton of paper produced are about as follows:

USE	TREATED WATER
Wood yard	388
Digester	2,340
Washing and screening	11,100
Refining	100
Paper	3,970
Caustic	1,650
Evap. and recovery	100
Power plant	1,590
Water supply	292
Total	21,530

The quality desired will vary somewhat from mill to mill, depending on the type of pulp produced and the equipment or method employed for treatment. The following are the minimum requirements in water quality for the manufacture of unbleached kraft pulp and paper:

ITEM	MAX. IMPURITIES, PPM
Turbidity as SiO_2[a]	25
Color in platinum units	5
Total hardness as $CaCO_3$	100
Calcium hardness as $CaCO_3$	50
Magnesium hardness as $CaCO_3$	50
Alkalinity to methyl orange as $CaCO_3$	75
Iron as Fe	0.1
Manganese as Mn	0.05
Silica (soluble) as SiO_2	20
Total dissolved solids	250
Free carbon dioxide as CO_2	10
Chlorides as Cl	75

In general, the water should be relatively soft and should be low in both turbidity and color. It should have a neutral pH and should be relatively free from heavy metals such as iron and manganese.

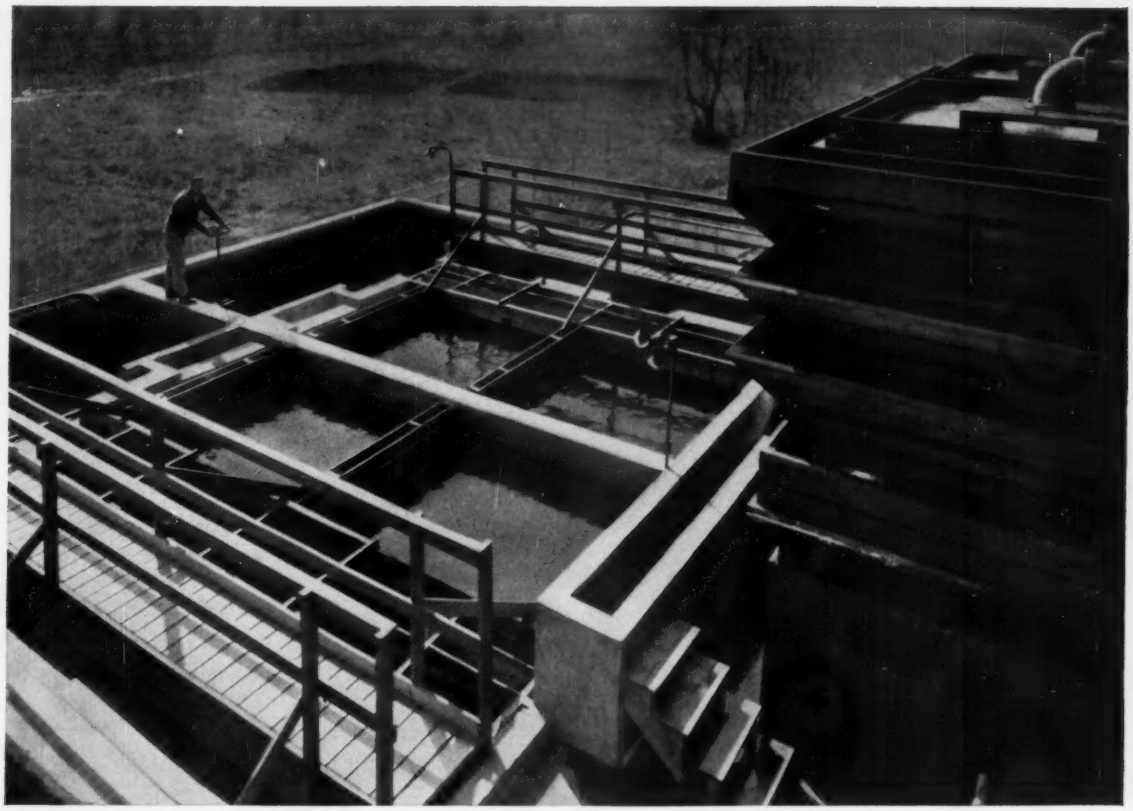
Chlorides are limited to 75 ppm because concentrations in excess of this amount tend to promote corrosion of metal parts in the manufacturing system. Calcium and magnesium compounds are limited to 50 ppm each because of their tendency to form scales on equipment and precipitates on the pulp where water comes in contact with the highly alkaline chemicals used in processing.

Each mill has its own individual water problems dictated by the source of the water and the desired paper quality. A suggested method for treatment would include prechlorination, coagulation with chemicals such as alum for turbidity and color removal, followed by lime addition for pH control. Chlorination is highly desirable to reduce and control slime growth in the mill water system since reclaimed water is used several times.

In conclusion, the principal factors to be considered in the establishment of a paper mill will be listed:

1. An adequate and sustaining wood supply produced and delivered at a reasonable cost to the mill.
2. An adequate water supply suitable for the type of paper produced.
3. Suitable transportation for wood, coal, chemicals and out-bound paper.
4. Present and potential market location for the finished paper.
5. A responsive community desiring new industry and also desiring a market for their raw materials and labor.

(This article is a shortened form of the paper presented by Mr. Reynolds at the ASCE Knoxville Convention, before a Construction Division session presided over by Alexander Brest, a member of the Division's Executive Committee.)



Raw well water with 30 parts per million of iron enters the double coke-tray Permutit *Aerator* (right) which oxidizes the iron and reduces CO_2. Next step is the Permutit *Precipitator* (left) where lime is added to raise pH and precipitate the iron . . . clay to thicken the precipitates. The resulting floc forms a suspended sludge blanket that speeds the chemical reaction . . . makes it more complete. Final treatment is by 5 Permutit Pressure Filters which remove remaining traces of precipitated iron and turbidity to deliver clear, iron-free effluent.

How *Fairless Hills* reduces iron from 30 to 0.14 ppm!

Fairless Hills, Pa., was built from the ground up to a community of 6,500 in less than 4 years . . . yet, because of good planning, there has never been a water supply problem. Before construction began, the search for water was underway.

The first test wells were disappointing . . . couldn't deliver enough. The nearest river water supply was too dirty and within the tidal basin. And when an adequate well water supply was discovered, it was acid and contained not just the usual few tenths ppm of iron but well over 30 ppm . . . 100 times the allowable standard!

Since even a few ppm of iron are considered difficult to handle, 30 parts presents a real problem. Because of the efficiency of its unique sludge-blanket design, a Permutit *Precipitator* was provided under specifications prepared by Consulting Engineer Howard A. LeVan, Jr. of Harrisburg, Pa. The unit was guaranteed to reduce iron to not more than 0.3 ppm.

"Now, the iron content is 0.14 ppm and the pH is 9.0. This equipment is doing a good job," reports H. D. Markle, Chief Engineer for the builders.

"In 29 years around the country, I've seen numerous Permutit installations doing a good job," adds Township Sup't. of Sewage and Water Supply, W. W. Willis.

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This is U. S. Highway 64 near Somerville, Tenn. —a concrete road built in 1929. Now 27 years old, it's still on the job! This long service is typical of the durability of hundreds of miles of concrete roads in Tennessee. Here's the record:

Total mileage of concrete roads built in Tenn.....2,124

Mileage still in service (exposed or serving as the heavy-duty, load-carrying base under a thin layer of resurfacing)..2,120

Mileage more than 20 years old and still in service (exposed or resurfaced).....1,457

Look at the record in another way: Of all the concrete roads ever built in Tennessee 99.8 per cent is still serving. What's more, over two-thirds of this durable paving is more than 20 years old.

This performance is a record of low-annual-cost highway service to taxpayers in Tennessee. The future record will be even better for *engineers now can build concrete roads to last 50 years and more.*

Besides great durability, concrete roads have much lower maintenance cost and provide greater safety—night or day, wet or dry.

All over America, motorists and taxpayers are looking to engineers and public officials for better, longer-lasting, lower-annual-cost roads. As the record proves, concrete pavement will do that job. For more information about designing and building durable, low-annual-cost concrete roads write for helpful free literature. Distribution is limited to the United States and Canada.

PORTLAND CEMENT ASSOCIATION Dept. 7-13, 33 West Grand Avenue, Chicago 10, Illinois

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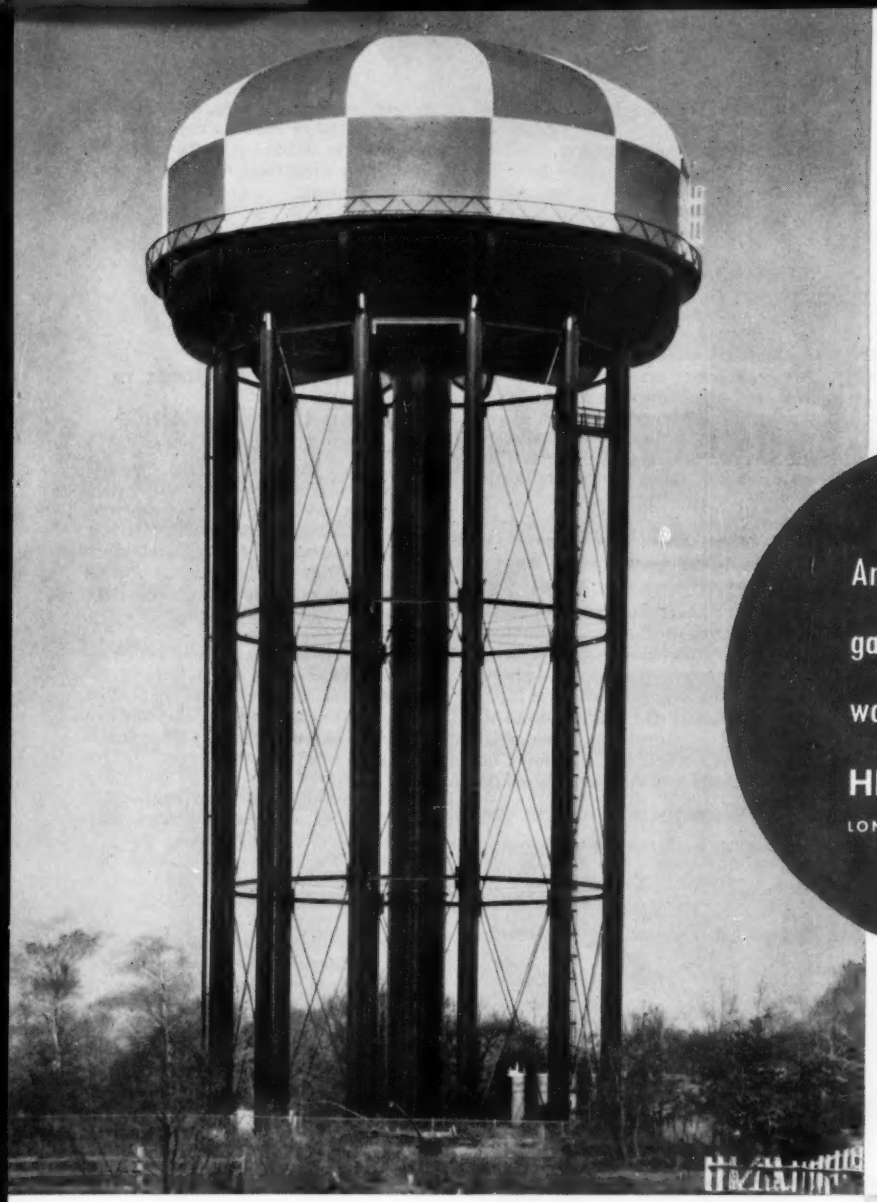

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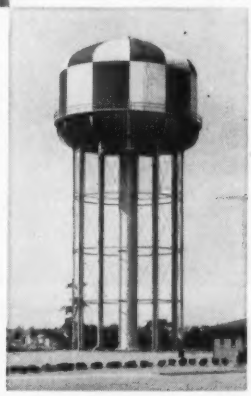

Elevated Steel Tanks by

PITTSBURGH-DES MOINES

Latest of the many PDM Elevated Steel Tanks towering over Long Island's level terrain is this 1,500,000-gallon Radial Cone installation for Hempstead. 88 ft in diameter, the tank has a headrange of 35 ft and is on a tower 135 ft to bottom of capacity. Shown at right is an earlier million-gallon PDM tank of the same design, built for Hempstead in 1951.

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PDM
ELEVATED STEEL TANKS

(*Continued from page 67*)

for fuel costs and electrical costs are much too high. The Office of Saline Water, U. S. Department of the Interior, recommends using cost figures for fuel of 25 cents per million BTU, and for electrical power in large blocks of around 0.5 cent per kwhr.

On this basis, the fuel costs for the three evaporation-type processes given in Tables IV, V, and VI respectively, would be more than cut in half. For the three-effect evaporator, the fuel cost would be $0.88 instead of $2.00 as listed, and the total cost would then become $1.23 per thousand gallons of finished water. The vapor compression process would show approximately 9 cents for fuel cost, making a total of 72 cents overall. The flash-type process given would have a fuel cost of approximately 37 cents, so that the overall cost per thousand gallons would be approximately 91 cents instead of $1.37.

These figures are based on the assumptions that the fuel is of first class, and burned solely for the purpose of operating the distillation equipment. It is in fact possible to operate the multiple-effect submerged-tube evaporators and the flash-type evaporators from a variety of sources utilizing otherwise wasted energy, which, if done, would reduce the costs still further. These figures are still not comparable to the costs for the electrodialytic process, especially after the correction for power cost, for the conditions treated in the article, but they do make the break-even point come at a much lower salinity content.

S. F. MULFORD
Engineering Department,
The Griscom-Russell Co.
Massillon, Ohio

More help for students in choosing their specialties

TO THE EDITOR: Student member Anderson was correct in his observation that orientation for choice of an engineering vocation is difficult at the student level. It is doubtful whether satisfactory orientation can ever be achieved because of the complexity of job types and the fact that the beginning student simply does not "know the language."

Most professional engineers can probably remember when, as students on the threshold of an engineering education, they questioned, "How am I to choose a branch when I don't know what a person in a particular field really does." Then they probably concluded that they couldn't possibly decide until they had had some training or experience in the field, which completed their dilemma.

The ways in which people use an engineering education as a means of procuring a livelihood are unlimited, but the major job types finally emerge fairly well defined, once they have been sorted out.

A convenient source of the needed descriptions and classifications is the "jobs available" column of a publication such as CIVIL ENGINEERING and there are similar publications for most other branches of the profession. These job announcements must define the work involved to some extent, thus providing an introduction to job titles and at least a starting point for further investigation. They may also indicate the relative demand for various types of jobs, the qualifications (which make education meaningful), and the compensation, all of which are relevant to a decision. Also these ads indicate the specific subsidiary specialties among which the eventual choice lies.

It will be quickly seen, for instance, that some jobs lend themselves to academic classifications such as "structural designer" and that others are more general academically speaking, but no less specific, such as "construction manager with experience in petroleum industry."

I believe, perhaps too optimistically, that most practicing engineers eventually feel they have made the right decision. Probably many would be unable to say whether they deliberately made their choice on a rational basis at each turning point, or whether rather, the governing factors were instinct and expediency, and a tendency to take advantage of the opportunities at hand.

RICHARD C. GAMBLE, J. M. ASCE
Design Engineer, West Virginia Pulp & Paper Co.
Charleston, S.C.

Can you identify these areas?

The photos below were taken by Fairchild aerial photo crews during routine survey flights.

More than material for a guessing game, they demonstrate the various services provided by Fairchild: magnetometer surveys for the geologists; detailed photomaps for the city planner; and topographic maps for the civil engineer. All of them have learned that when aerial surveys are needed fast, and must be right the first time, they can depend on Fairchild.

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2. Jetty construction, Jones Inlet, Long Island, N. Y.
3. Death Valley, California
4. Los Angeles Harbor, Los Angeles, California

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STANDARD MC-3 Cut Back Asphalt is applied to Boulder County Highway 10. Standard Asphalt engineer Oscar Jones (left) and Highway Superintendent Douglas N. Stewart check application.

Ordering STANDARD Asphalt

makes job easier for Boulder County Highway Department

As the link between Longmont and State Highway 66, Boulder County Highway 10 gets plenty of traffic. To take this traffic, road is surfaced with STANDARD Asphalt.

Boulder County Highway 10 in Colorado links the city of Longmont with State Highway 66 three and a half miles to the west. It is a popular highway for travel to Rocky Mountain National Park and for farm-to-city traffic. Maintenance of this highway in first class, all-weather condition is made easy by the use of STANDARD Asphalt. The Boulder County highway department gets these benefits from ordering asphalt requirements from Standard: (1) top quality product and (2) an assured source of supply.

And there are still more advantages to ordering asphalt from Standard Oil. Standard's experienced asphalt salesmen know the needs of road builders and are qualified to work with them in planning requirements. Standard Oil has long experience as an asphalt supplier, knows what it means to protect customers on supplies and deliveries.

You can get these advantages when you buy asphalt from Standard. Find out. Call your nearby Standard Oil Office in any of the 15 Midwest and Rocky Mountain states, or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD **STANDARD OIL COMPANY (Indiana)**

Highway 10 running west of Longmont, Colorado to State Highway 66 is 24 foot wide, asphalt surface, all weather highway. Standard Oil's Oscar Jones and Highway Superintendent Douglas N. Stewart inspect road recently resurfaced.

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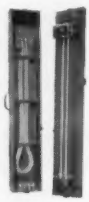

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RECENT BOOKS

American Universities and Colleges

This seventh edition of *American Universities and Colleges*, edited by Mary Irwin, brings up to date a classic reference for student counselors, college administrators, researchers, and writers. It provides full descriptive data on 969 accredited universities and colleges in the United States, Alaska, Hawaii, and Puerto Rico—72 new accreditations since the 1952 edition—and brief data on 2,016 approved professional schools in 23 fields. Seven chapters on the administration and organization of higher education in the United States constitute another important feature. (American Council on Education, 1785 Massachusetts Avenue, Washington 6, D.C. 1210 pp., $12.00.)

Engineering in History

This is a general introduction to the subject, devoted to recording the most significant achievements in certain branches of civil, mechanical, electrical, and metallurgical engineering. Engineering history is integrated into general history with the intent of showing how social conditions influenced engineering advances and how these in turn influenced the development of Western civilization. Selected references are listed after each chapter, and a general bibliography is given at the end of the book. The authors are R. S. Kirby, S. Withington, A. B. Darling, F. G. Kilgour. (McGraw-Hill Book Company, 330 West 42nd St., New York 36, N.Y. 530 pp., bound $8.50.)

History of American Technology

This is a comprehensive account by John W. Oliver of the status and development of the various areas of technology—mining, manufacture, transportation, communication, etc.—during each of the four historical periods into which the book is divided: pre-Revolutionary, Revolution to Civil War, Civil War to 1900, and 1900 to the present. Stressed throughout is the influence of technological progress on the economic and political growth of the United States and on American civilization as a whole. (The Ronald Press Company, 15 East 26th St., New York 10. 676 pp., bound $6.50.)

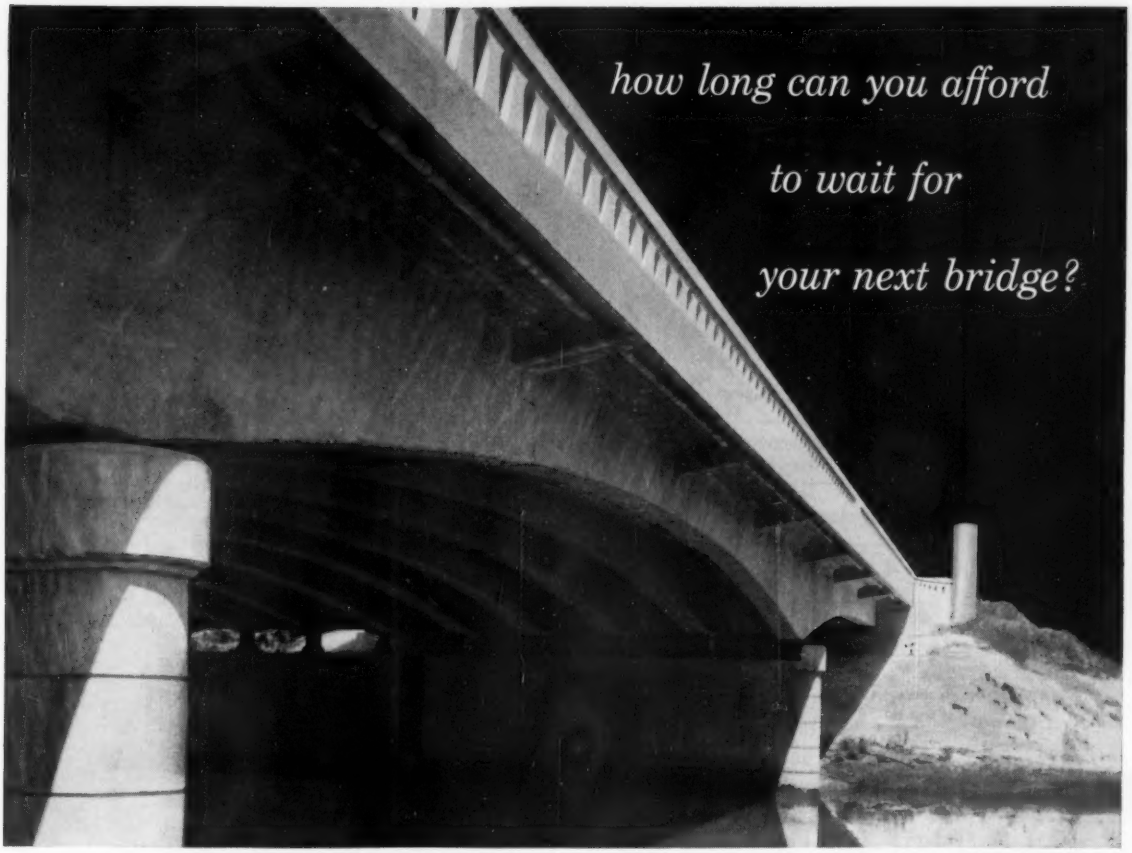
Introduction to Plasticity

A treatment of metal plasticity, written from the viewpoint of the stress analyst and intended for advanced students and practicing engineers. The first six chapters deal with one-dimensional problems: the behavior of an indeterminate truss as influenced by the plastic behavior of its members; plastic design of beams and frames; plastic bending; deflections of statically determinate and statically indeterminate beams and frames; and the theory of curved bars. The last three chapters deal with problems of combined stress: the stress-strain relations of plasticity, plastic design of structures, and strain hardening. The author is Aris Phillips. (The Ronald Press Company, 15 East 26th Street, New York 10, N. Y. 230 pp., bound. $7.00.)

Legal Problems in Engineering

The section of this book devoted to specifically engineering-legal problems covers construction contracts and specifications; governmental regulation of business; patents, copyrights, and trademarks; and air and stream pollution. In addition, the book includes a section dealing with engineering ethics and professional registration, and another explaining the legal principles involved in contracts in general, sales, insurance,

(*Continued on page 104*)



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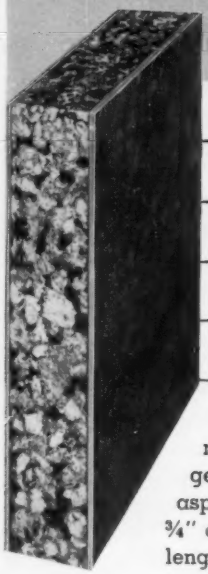

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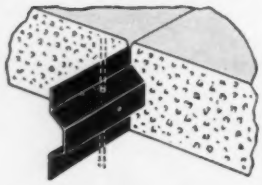

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Recent Books

(*Continued from page 102*)

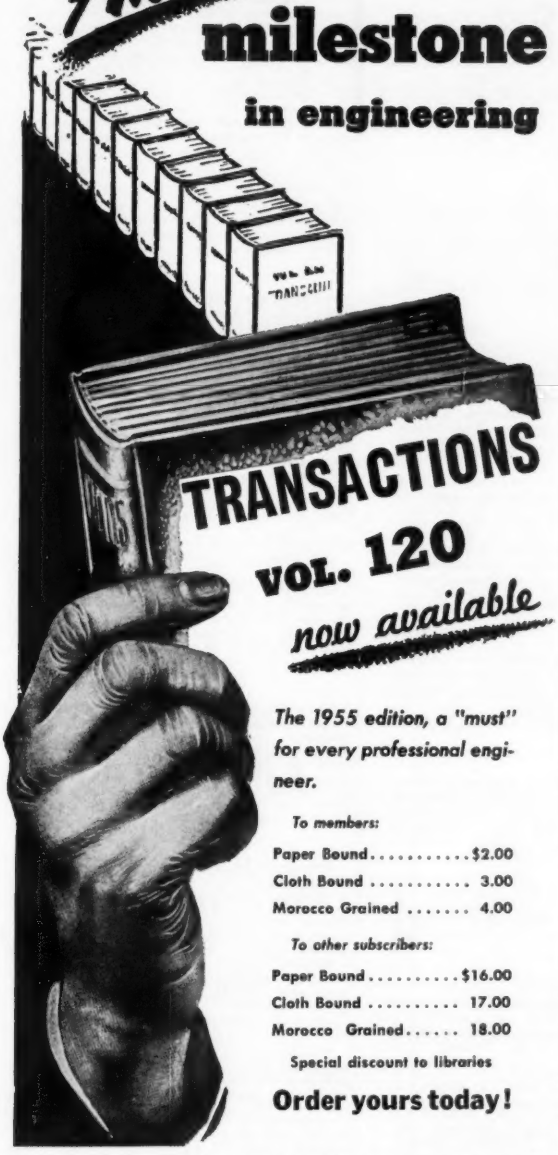
workmen's compensation, partnerships, municipal corporations, and other subjects of interest to engineers. Cases used to illustrate the discussion are given in condensed form and simplified language. The author is Melvin Word. (John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N.Y. 391 pp., bound. $7.50.)

New in Education

New Courses. To assist practicing structural engineers to develop and improve their knowledge in the field of dynamic loading, a two-week Special Summer Program in "Structural Design for Dynamic Loads" will be given at the Massachusetts Institute of Technology August 6 through 17. Details and application blanks may be obtained from the Summer Session Office, Room 7-103, MIT, Cambridge 39, Mass. . . . . The University of Michigan announces a two week intensive course on Nuclear Reactors and Radiations in Industry to be given at Ann Arbor, August 20 to 31. The course is sponsored by the Nuclear Engineering Committee of the College of Engineering, and will be conducted by members of the engineering staff, assisted by guest lecturers. Further details from Prof. William Kerr, Department of Electrical Engineering, University of Michigan, Ann Arbor. . . . . A traffic engineering short course will be held at Purdue University, Lafayette, Ind., August 6 to 10. Theme of the course will be "Engineering Aspects of Traffic Operation." Special attention will be given to the problems of smaller cities, though traffic engineers in larger jurisdictions and in state service will also find the course valuable. Further information from Prof. Don Berry, School of Civil Engineering, Purdue University, Lafayette, Ind. . . . . Wayne University Computation Laboratory offers its fourth Summer Program for training personnel in computer activity. Persons interested in automatic data processing and computing will find the course helpful. Courses will begin July 23 and run through August 11. Information from A. W. Jacobson, Special Summer Program, Wayne University, Computation Laboratory, Detroit 1, Mich.

Fellowships and Grants. Applications will be accepted through September 4, 1956, for the second group of senior postdoctoral fellowships to be awarded by the National Science Foundation during the current calendar year. Fellowships will be awarded in mathematical, physical, engineering and other sciences. Further details from the Division of Scientific Personnel and Education, National Science Foundation, Washington 25, D.C. . . . . The National Science Foundation has awarded $13,000 dollars to Carnegie Institute of Technology for studies aimed at diminishing air pollution. Principal investigator will be George Westinghouse Professor of Engineering, Gaylord W. Penny.

Another milestone in engineering



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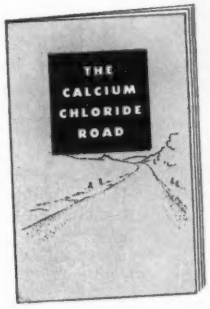

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This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL ENGINEER, J.M. ASCE; B.S. in C.E., 1951; 27; single. Experienced in highway design, layout, and construction; supervisory design experience on plans, estimates, and specifications for general military construction. Desires position with consulting engineering firm. Eastern location preferred, but will relocate if necessary. Available October 1. C-137.

JUNIOR ENGINEER, BUILDING CONSTRUCTION, J.M. ASCE; civil; 29. Built several homes, self employed. Location desired, West or Midwest. C-138-Chicago.

CIVIL ENGINEER, STRUCTURAL, J.M. ASCE; B.S. in 1954; 24; 2 years' varied experience in surveying, residence remodeling, machine-tool design, and detail drafting. Interested in active field work, abroad or with extensive travel. C-139.

SANITARY ENGINEER, J.M. ASCE; B.S., M.S.; 26; Lt.Jg., USNR Civil Engineer Corps; 3 years' experience in public works and construction supervision; 2 years' experience in sanitary engineering, research. Desires sanitary or hydraulic engineering design position with design and/or consulting firm. Location desired, West. C-140.

CIVIL ENGINEER; A.M. ASCE; 50; responsible experience in administration, planning, construction of earth dam, design and construction of steel and reinforced concrete structures, drawing office, specifications, estimates, project reports; desires employment in reputable civil engineering firm for gaining experience in latest construction methods. Qualified in all phases of field and office work, including contract negotiation and job management. Now in India, but coming to the United States. C-141.

Positions Available

CIVIL ENGINEERS for sanitary engineering consulting firm. (*a*) Specification Writer; (*c*) Sanitary Engineer. (*d*) Draftsman. Salary plus benefits. Location, New York, N.Y. W-3232.

INSTRUCTOR-ASSISTANT PROFESSOR, with at least a B.S. in civil, to teach surveying, photogrammetry, highway, and engineering mechanics, including four weeks' summer surveying camp. Salary, $6,000–$6,800 a year. Location, New York metropolitan area. W-3356.

SOLIDS FUELS ENGINEER-OPERATOR, 30–38, degree in mining, civil, or mechanical engineering, with 10 to 12 years' experience in coal operations. Must have underground experience, with some experience in deposits, costs of operating, mine facilities, open-pit mining, and operations methods desirable. Should be familiar with latest developments in mining equipment and machinery. Salary open. Location, West Coast. W-3367.

HIGHWAY ENGINEER, with 10 to 15 years' supervisory experience on construction of highways and bridges. Salary open. Location, Colombia, South America. F-3375.

TEACHING PERSONNEL for general engineering department, with degrees in electrical, mechanical civil, and industrial engineering. Position available September 1956. Rank and salary open. Location, West. W-3387.

RECENT GRADUATE ENGINEERS, civil, electrical, mechanical, mining or metallurgical, for mining properties in South America. Salaries, from $6,000 a year. Company will pay placement fee. Transportation and living quarters provided. Single status. Location, South America. F-3407.

CIVIL ENGINEER, to handle pipeline and compressor station construction projects. Salary, $4,800–$5,100 a year, to start. Location, Ohio. W-3411(*c*).

ENGINEERS. (*a*) Construction Superintendent, with at least 10 years' supervisory experience in chemical process construction. Salary, $10,000–$12,000 a year. (*b*) Job Engineer, with at least 10 years' field and office engineering experience in industrial or process construction. Salary, $7,800–$9,000 a year. Location, Long Island, N.Y. W-3426.

ENGINEERS. (*a*) Construction Superintendent, prefer graduate, to 60, with thorough experience on large construction with at least three to four positions as superintendent of office building construction. Will be responsible for supervising work on large reinforced concrete office buildings and subcontractors and liaison. (*b*) Construction Superintendent-Power Plants, graduate preferred with thorough background in supervising construction of large utility steam electric stations, with duties similar to above; to 60. (*c*) Construction Engineer, graduate civil, with construction experience on power plants or large industrial buildings, to 40; will assist construction manager in planning, scheduling, writing, and negotiating proposals and contracts, providing liaison between field construction projects and engineering department. Salaries; (*a*) $13,000; (*b*) $13,000; (*c*) to $8,400 a year. Location, New York, N.Y. W-3436.

LIAISON ENGINEER, civil or mechanical graduate, with administrative and office engineering experience, including construction costs in chemical or metallurgical process fields. Occasional trips. Salary, $8,0000–$9,000 a year. Location, New York, N.Y. W-3441.

TOWN ENGINEER, graduate civil, with P.E. license, 30–45, with experience in town planning, roads, structures, etc. Salary, $6,500–$7,000 a year. Location, Westchester County, New York. W-3444.

CIVIL ENGINEER, registered, preferably with municipal engineering background, capable of organizing a new department and running it to service the town government. Salary, to $8,500 a year. Location, Connecticut. W-3462.

STRUCTURAL ENGINEER, graduate, with 12 to 14 years' responsible design experience. Must be licensed engineer and should have assumed full responsibility on some large engineering work. Salary, $9,600 a year. Location, Florida. W-3467.

ENGINEERS (*a*) Hydraulic Engineer, familiar with hydraulic turbine work, design and application. This experience necessary. Salary, $8,000–$9,000 a year. (*b*) Draftsman, mechanical, with experience on hydraulic turbines. Salary, $,6000–$6,500 a year. Company will pay placement fee. Location, Midwest. W-3471.

ENGINEERS, experienced in structural steel, to design structural steel, make take-offs from plans, and draw plans for shop and sealed use. Salary open. Location, northern New England. W-3513.

RELOCATION ENGINEER, 40–55, on railroad and highway relocation in reservoir of hydroelectric project; must be experienced in railroad and highway engineering with minimum of 10 years in responsible charge of this class of construction. Salary, to $12,000 a year. Location, Southwestern U. S. W-3529.

SANITARY ENGINEER, experienced in the design of sewage and water treatment plants. Apply by letter stating experience, salary, and availability. Location, New York State. W-3536.

EXPERIMENTAL PRODUCT ENGINEER, B.S. in M.E., E.M., Met. E., C.E.; 30–50; with minimum of 5 to 10 years' experience required in design and/or development, with aptitude for basic product development. Knowledge of design and development principles and evaluation. Duties: responsible for basic design of experimental product to meet defined requirements; determination of limitations, compromises, fulfillments of design requirements through media of calculations, drawings, reports experimentation, and test; selection and specifications of materials for the product as established by the design. Advise and counsel product engineers during designing for production. Salary $5,700–$7,200 a year. Employer may negotiate the placement fee. Location, Midwest. D-3001.

JUNIOR ENGINEERS, petroleum, mechanical, civil or physics, with 2 or more years' experience in drilling or production operation in petroleum industry. Will do training for drilling, refining or for work in the petroleum industry for a refiner of petroleum. Employer will pay placement fee. Salary, $5,700–$6,600 a year, plus moving expenses. Location, Oklahoma. C-5068.

SOILS ENGINEER, graduate, 35–55, with 10 years' experience in field and laboratory on soil mechanics and a knowledge of earth dams; to supervise field work and soils lab in connection with center core rock-fill dam. Also some work on compacted earth lining of irrigation canals for a consulting engineer. Employer will pay placement fee. Salary, $10,000–$12,000 a year. Location, Japan. C-5084.

RESIDENT ENGINEER, engineering graduate, 40–60, with 20 years' experience supervising construction of dams and hydraulic structures. A knowledge of rock-fill dams helpful. Will do general supervision of construction of a large center core, rock fill dam and chute spillway requiring difficult foundation treatment. Will supervise work of several U.S. engineers and Japanese inspectors. Employer will pay placement fee. Salary, $14,000–$16,000 a year. Location, Japan. C-5085.

EQUIPMENT ENGINEER, 35–60, with 10 years' experience in selection, maintenance, and operation of heavy construction equipment and knowledge heavy engineering construction, to work in office on selecting and purchasing construction equipment for a rock-fill dam, tunnels and canals; to supervise in Japan the operation and maintenance of same for a consulting engineer. Employer will pay placement fee. Salary open. Location, Chicago. C-5086.

FOUNDATION ENGINEER, 35–60, with 10 years' experience in foundation exploration and grouting for dams; will supervise foundation exploration and grouting for a dam on difficult rock strata. For consulting engineer. Employer will pay placement fee. Salary, $10,000–$12,000 a year. Location, Japan. C-5087.

RESIDENT ENGINEER—CANALS, graduate, 40–60, 20 years' experience in field work on irrigation canals and hydraulic structures. Know irrigation canals; to supervise relocation of 75 miles of main-water distribution system (1,000 cfs maximum flow) construction of open canal, tunnel, siphon, etc., in somewhat rough country. Studies of type of lining, construction equipment and methods, and supervision of construction for consulting engineer. Employer will pay placement fee. Salary, $14,000–$16,000 a year. Location, Japan. C-5088.

Positions Announced

U. S. Navy. Overseas opportunities for graduate engineers with the Navy in Guam (18 months) and Hawaii (24 months) as Junior Engineers in civil, mechanical, sanitary, structural and other branches. Engineers GS-5 (salary $4,480) and engineers GS-7 (salary $5,335) per annum, plus a 25 percent territorial post differential on Guam and a 20 percent cost of living allowance in Hawaii. Transportation overseas and return is provided with travel in a pay status. Transportation provided for family when authorized. Obtain a Standard form 57 from your Post Office, State Employment Service office, or campus student placement office. Fill out and send to Navy Overseas Employment Office (Pacific), 45 Hyde Street, San Francisco, Calif.

City of Pasadena. The City of Pasadena offers unlimited opportunities to young engineers interested in a public works career. Future retirements will open opportunities, with wages and benefits equal to the best. Applications should be made to the Personnel Department, City Hall, Pasadena, Calif.

County of San Diego. The Department of Civil Service and Personnel has openings for Assistant Cadastral Engineer (salary range from $483 to $532 per month); Associate Sanitary Engineer, with salary range from $559 to $587 per month (proposed range $616 to $647); Junior Civil Engineer, with salary range from $397 to $483 (proposed range $438–$532); Public Health Engineer, with salary range from $647 to $713 per month (proposed range $713 to $786). Examinations must be taken in order to qualify. Application forms from Clayton G. Swanson, Director of Personnel, Department of Civil Service and Personnel, Room 402, Civic Center, San Diego 1, Calif.

University of Kansas. Instructors to teach undergraduate courses in applied mechanics. Opportunity to work toward graduate degree in any engineering department. Salary depends on qualification of applicant. Department of Applied Mechanics, University of Kansas, Lawrence, Kans.

Non-ASCE Meetings

National Council of State Boards of Engineering Examiners. Thirty-fifth annual meeting at the Hotel Statler, Los Angeles, August 23–25. Details from T. Keith Legare, Executive Secretary NCSBEE, Palmetto State Life Building, P. O. Drawer 1404, Columbia, S.C.

American Society of Mechanical Engineers. Fall meeting at the Cosmopolitan Hotel, Denver, Colo., September 10–12. Information from T. A. Marshall, Jr., Assistant Secretary ASME, 29 West 39th Street, New York 18, N.Y.

Applications for Admission to ASCE May 12–June 9, 1956

Applying for Member

FRANK GILMORE ALSTON, Pittsburgh, Pa.
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GOMER HOBART BITTLE, Oklahoma City, Okla.
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SAMUEL CLARK CANNON, Middletown, Conn.
ANDREW CANZANELLI, Cambridge, Mass.
CHARLES ALFORD CONE, Tulsa, Okla.
KENNETH CLARK DEEMER, Lawrence, Kans.
IVAL VINTON GOSLIN, Grand Junction, Colo.
JAMES RICHARD GRAVES, Austin, Tex.
EDWIN BRUCE L. GREEN, Westwood, N. J.
RAYMOND LESLIE HILL, Wilmington, N. C.
LEONARD JOHN JOHNSON, Indianapolis, Ind.
ROLLAND FARRINGTON KASER, New York, N. Y.
ANTHONY JUSTIN KRANASKAS, Bogota, Colombia.
JOHN EVAN MCCALL, Washington, D. C.
LAWRENCE GARLAND MCLEAN, Phoenix, Ariz.
LORENZ STEWART MORGAN, Harrisburg, Pa.
MOSES LIDDELL RANDOLPH, Honolulu, T. H.
HERBERT KENNETH RIGSBEE, Austin, Tex.
FRANCIS ARTHUR RYNDERS, Milwaukee, Wisc.
NORMAN HENRY SCHWEINBERG, Pittsburgh, Pa.
JOE AUBREY SHELBY, Austin, Tex.
VICTOR VITO SHUMSKY, North Augusta, Ga.
CLARENCE ALFRED STOLDT, Oklahoma City, Okla.
GEORGE BULKELEY WESTON, JR., Mobile, Ala.
A HUGH WHITMORE, Glendive, Mont.
JOSEPH PERCIVAL WILKINSON, Pittsburgh, Pa.

Applying for Associate Member

WALTER BABCHUK, Los Angeles, Calif.
HENRY AME BABCOCK, Golden, Colo.
BURCH CASPAR BACHTOLD, San Francisco, Calif.
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(*Continued on page 108*)

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Stress Department—Experienced Structural Engineers for positions on Long Range Interceptor Project and on advanced missile designs.

A wide diversification of assignments within each field of specialization awaits the men capable of filling the above assignments. Responsibilities will include work on many phases of missile and aircraft design, guidance systems and boundary layer research.

If you qualify for any of these challenging opportunities, we invite you to contact Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., Hawthorne, California, or call ORegon 8-9111, Extension 1893.

NORTHROP AIRCRAFT, INC.

PIONEERS IN ALL WEATHER AND PILOTLESS FLIGHT

5-A-49-B

Applications for Admission to ASCE, May 12–June 9, 1956

(*Continued from page 107*)

ARTHUR KARLIN BERNSTEIN, Baltimore, Md.
LYNN ALLEN BRAUER, Chicgo, Ill.
DONALD JOSEPH BUTLER, New York, N. Y.
RANIBDRA NATH CHATTERJEE, Calcutta, India.
JOSEPH ALBERT DEVITO, New York, N. Y.
FRANCIS JOSEPH DORSEY, New York, N. Y.
EDWARD MONTEITH DOUGHERTY, Nashville, Tenn.
ALEXANDER DROGIN, Bayonne, N. J.
ROHN FRANK DRYE, JR., Little Rock, Ark.
MOHAMED NOUREDDINE EL RIFAI, Berkeley, Calif.
SAVERIO CESARE FABOZZI, Milano, Italy.
JOE J. FISHER, Los Angeles, Calif.
HUGO GAMBARTE-PANTOJA, La Paz, Bolivia.
RUSSELL FREDERICK GEISSER, Providence, R. I.
JALIL HASSANI, Baltimore, Md.
KAZUYOSHI KAWATA, Punjab, India.
WILLIAM NORMAN KENNEDY, Berkeley, Calif.
JEROME LAMPRECHT, Baltimore, Md.
MARK HODGE LACKEY, Cochabamba, Boliva.
HSIN-KUAN LIU, Fort Collins, Colo.
ALLAN ALBERT GEORGE MCDERMOTT, Jamaica, B. W. I.
DEE WILLIS MCKENZIE, Sacramento, Calif.
ANDRES MORALES COLLAZOS, Bogota, Colombia.
MICHAEL NIKCEVICH, Chicago, Ill.
JOHN TROUT NORGAARD, Oakland, Calif.
MILTON PIKARSKY, Chicago, Ill.
ROLAND DALE REEVES, Omaha, Nebr.
JACK QUINCY RICHARDSON, Cleveland, Ohio
FRED LOUIS RUTH, Walla Walla, Wash.
RICHARD NICHOLAS SEEMEL, Paso Robles, Calif.
JOHN ARNOLD SHAW, Plumstead, S. Africa.
ALAN URQUHART SHIACH, London, England.
TRIVELLORE ECHAMBADI SRINIVASAN, Rangoon, Burma.
MARK LEONARD STUPPY, Pittsburgh, Pa.
WILLIAM JORDAN SULLIVAN, Buffalo, N. Y.
VICTOR JOHN RONALD SUTTON, Aden, Arabia.
THOMAS PHILIPPUS PETRUS VAN GRAAN, Kimberly, Union of South Africa.
HANUMANTHAPPA VENKATACHALA MURTHY, Chicago, Ill.
EARL WAGNER, Fort Worth, Tex.
M. THURSTON WARD, Roanoka, Va.
DEXTER MAYNE WELTON, Troy, N. Y.
JOHN DANIEL WHITE, Savannah, Ga.
DAVID LAWRENCE WIEMAN, San Bernardino, Calif.
ROBERT CHIA-YUNG YOUNG, New York, N. Y.
MICHAEL GEORGE ZELEZNAK, Kansas City, Mo.

Applying for Affiliate

JOHN DWIGHT LANG, Baltimore, Md.

Applying for Junior Member

ZAFAR IRSMAD AHMAH HASHMI, Salt Lake City, Utah.
MICHAEL CHARLES AVINO, East Northport, N. Y.
JOSE COUTO SILVA GOMES BACELLAR, Sao Paulo, Brazil.
DAVID JOHN BACH, Toledo, Ohio.
ERNEST JOHN BARENBERG, Lawrence, Kans.
LLOYD VAUGHN BELING, St. Paul, Minn.
JOSEPH WELLIE ROLAND BOISVERT, Cambridge, Mass.
NICHOLAS DITULLO, Philadelphia, Pa.
DONALD RICHARD DREW, Fort Bliss, Tex.
CLEMENT JOHN FINNEY, JR., San Francisco, Calif.
OLIVER HARDIN GILBERT, JR., Quincy, Mass.
ANDREW JACKSON GLENN, III, Atlanta, Ga.
JOHN EDWIN HILTON II, Bothell, Wash.
DONALD NORDNESS HOFFMAN, Thule, Greenland.
MERIH KAZMIRCI, San Francisco, Calif.
ALBERT IGNATIUS KING, Hong Kong, China.
DENNIS JERRY KOUTAVAS, Turtle Creek, Pa.
HARDY LATTIMER LACOOK, JR., Memphis, Tenn.
DIRK NICO MICHIEL LOOIJENGA, Portland, Ore.
HENRY DOUGLAS LUNT, Cedar City, Utah.
JACK BUFORD MATSON, Ann Arbor, Mich.
LEONARD MEIROVITCH, Los Angeles, Calif.
RONALD EUGENE MONTGOMERY, Yuma, Ariz.
HAROLD LEONARD NELSON, Minneapolis, Minn.
FRANK RICHARD QUIBLE, Richmond, Va.
WAYNE LEROY RICKERD, Los Angeles, Calif.
LOEN ABRAHAM RISEMBERG, Hollywood, Calif.
LESLIE BRANT ROBISON, Cape Girardeau, Mo.
RAMNIKLAL SAKALCHAND SANGHAVI, Fort Collins, Colo.
JAMES BERRYMAN STOUTAMORE, Port Hueneme, Calif.
JOHN MARION SYDENSTRICKER, JR., Sao Paulo, Brazil.
GERALD HOWARD TELETZKE, Madison, Wis.

[*Applications for Junior Memberships from ASCE Student Chapters are not listed*]

Boeing's new Mach 4 tunnel: a vital step in the engineering art

Typical of Boeing's superb facilities, this new supersonic wind tunnel will lead to important civil engineering advances. It is capable of producing velocities four times the speed of sound and will be teamed with Boeing's present transonic tunnel for a research facility that will be the most advanced and versatile of its kind in private industry.

The knowledge of civil engineers is important in determining the configurations to be tested in the new tunnel. The tunnel will enable them to test new structures and materials under the extreme conditions of hypersonic flight. Civil engineers at Boeing are also important in structural analysis and testing, in developing new uses for titanium, magnesium and other materials, in structures design, in thermo and fluid dynamics, and many other fields.

In addition to the new tunnel, engineers find other advanced facilities at Boeing: the latest electronic computers, a chamber that can simulate altitudes up to 100,000 feet, a new multi-million-dollar Flight Test Center, and many more. This is evidence of Boeing's steady growth. The company now employs more than twice as many engineers than at the peak of World War II—and more engineers are needed.

Engineers who come to Boeing will find stimulating work, at the very frontiers of engineering knowledge. They will find individual recognition and opportunity for advancement in small, tightly integrated "teams" in research, design or production. And they and their families will enjoy living in the pleasant and progressive community of Seattle or Wichita. There may be a place for *you* in this challenging world of tomorrow at Boeing-Seattle or Boeing-Wichita. Won't you write and find out today?

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Boeing Airplane Co., Dept. D-53, Seattle 24, Wash.

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1. American Society of Civil Engineers members are dominant in all fields of engineered construction—26 major types of projects specifically mentioned.
2. One or more of almost all types of construction equipment are used by Civil engineers on these construction projects.
3. Civil engineers have a major influence in the specification of practically all construction material and installed equipment required to complete the 26 major types of projects.
4. Civil engineers are highly brand conscious and have definite brand preferences for virtually all construction materials and equipment.
5. Civil engineers hold important executive positions and have responsible charge of work in all areas of construction.
6. Civil engineers consult frequently and extensively with their opposite numbers in other organizations in the process of specifying and buying.
7. Civil engineers hold important positions in contractor organizations and select or directly influence the purchase of equipment.
8. Civil engineers in consulting or awarding agencies also influence equipment purchases.
9. Civil engineers spend almost twice as much time reading their Society magazine, CIVIL ENGINEERING, than any other business publication.

Engineers are educated to specify and buy!

CIVIL ENGINEERING

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North American's Missile Projects Offer A New Engineering Adventure

With complete weapons system responsibility for the SM-64 NAVAHO Intercontinental Guided Missile, North American is engaged in one of the most challenging programs yet offered. But every inch of progress is a tough scientific battle. New means are daily being found to solve the complex problems which the development of long range missiles presents in the fields of structures, temperatures and aerodynamics. But most important of all, *men* must be found who thrive on this kind of challenge . . . men who are really excited about this new missile science. Are you one of them?

If you qualify in one of the fields we have listed below, chances are you can qualify for this unique expedition into the technology of the future. We would like to tell you about all the physical and professional advantages of a career in North American's Missile Development Engineering.

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Aerodynamics **Engineering Flight Test** **High Temperature Materials Engineering** **Mechanical & Electrical Design**

Contact: R. L. Cunningham, Missile Engineering Personnel Office
Dept. 91-20CIV, 12214 Lakewood Boulevard, Downey, Calif.

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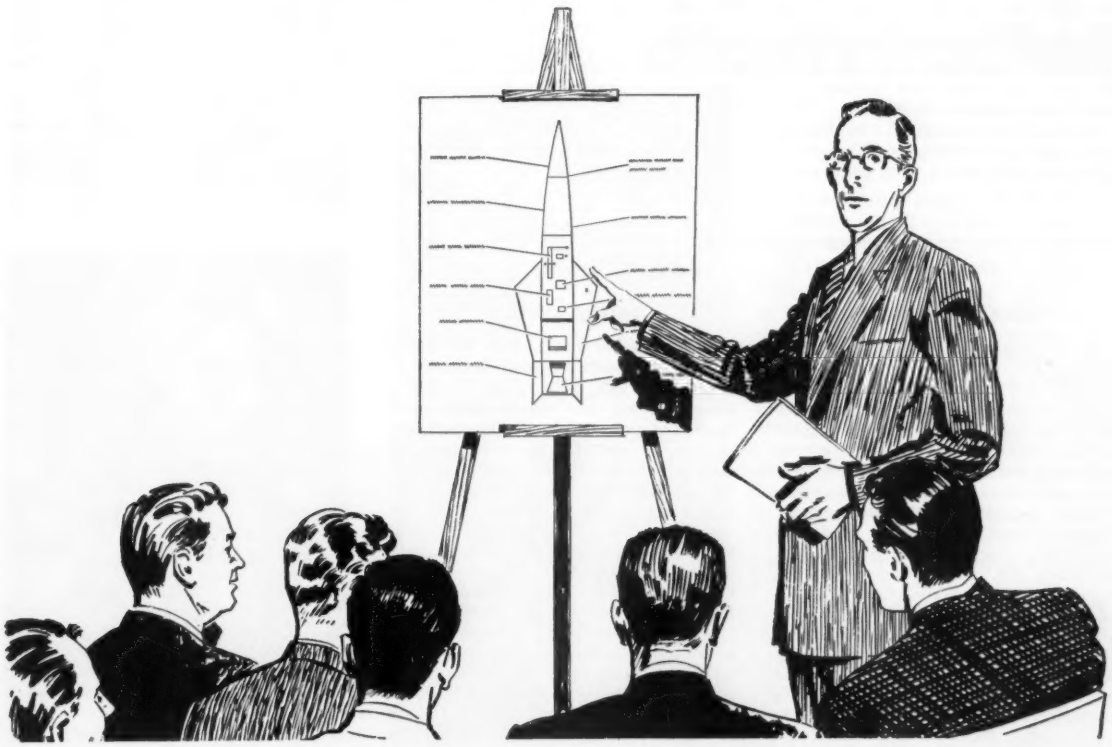
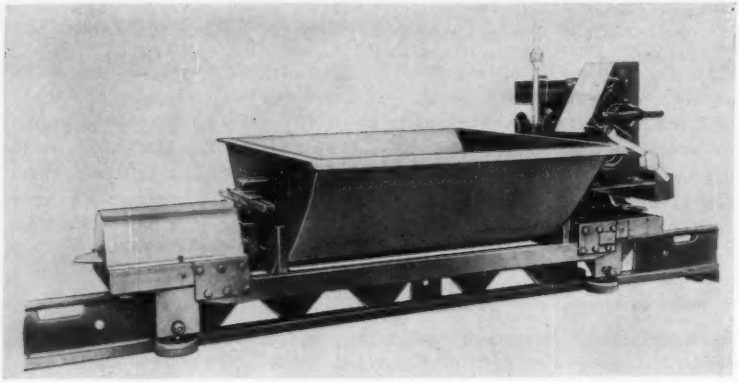


EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS



Rex Railporter

Portable Transport

COMPLETELY DIFFERENT IN IDEA and method of operation, the Rex Railporter, a portable transport for construction materials, runs on a single rail. Loaded at the point of supply and sent on its way by engaging a clutch lever, it follows the rail unattended to its destination where it stops automatically.

The Railporter maintains perfect stability and safety by means of stabilizing rollers which ride the lower flange of the single rail, stopping automatically when it reaches the stop-bolt which is set at a predetermined place in the rail. The stop-bolt trips the clutch and actuates the brake as the unit passes over it.

The single rail, on which the hopper runs, consists of sections, 4, 6, or 12-ft, which are supported at each joint by adjustable stands. These sections are easily set by two men, 100-ft of track in 20 min, over any type of ground condition. A slip pin connection joins the rail sections in seconds. Switches and curved rail are also available.

Easily spanning open cuts, excavations, reinforcements, mud or water, it is claimed the Railporter saves time and keeps work on schedule under any condition and eliminates the need for wooden runways and ramps. Self propelled and operating with one clutch lever for forward and reverse, it handles big and small jobs alike—carries liquids, bulk, package, block and other materials. It has a carrying capacity of 1400 lb. **Chain Belt Co., CE 7-112, 4600 West Greenfield Ave., Milwaukee 1, Wis.**

Asphalt Plant

A NEW, PORTABLE BATCH TYPE ASPHALT PLANT, built in capacities of 3000-lb, 4000-lb and 5000-lb per batch, is designed specifically for the medium and larger contractor.

In designing the Model 391 Hot Rod, the manufacturer states that emphasis was placed on producing a plant that would be extremely clean and simple in design, free of excess baggage, have a minimum of removable parts required to be dismantled for transport, and would handle the exacting requirements of today's bituminous mix specifications on a fast production basis.

The plant incorporates many engineering features never before offered such as the fully enclosed double reduction gear box that goes right into the mixer shafts eliminating the exposed mixer timing gears and the pressure injection pump motor.

The mixer weigh box assembly has many features which enables the owner to meet more exacting mix specifications, obtain faster production and reduce servicing and maintenance costs. The operator platform is located on the end of the plant away from dust, fumes and heat, and asphalt and aggregate scales as well as all controls, are conveniently located.

The Madsen Model 440 Twin-Shaft Pug Mill mixer is used in the Hot Rod. This mixer has liner sections which are externally installed and externally removed. These sections are ground to a width tolerance of .003-in. plus or minus, to assure interchangeability, a perfect fit and a quick installation. **Madsen Works, Construction Equipment Division, Baldwin-Lima-Hamilton Corp., CE 7-112, P. O. Box 38, La Mirada, Calif.**

Force Indicators

A NEW SERIES of precision force indicators with capacities of 50, 75, 100, 150 and 200-lb are available, extending to 18, the number of force indicators now being made by the firm. Designed for easy hand operation or for use in permanent test set-ups, the new Series D force indicators are capable of measuring all forces up to their maximum capacities. Equipped with compression head and hook, both of which are designed to be removable for substitution of special fittings, the units are constructed of cold-rolled steel. The Series D instruments use compensated spring mechanisms and fully jeweled dial indicators. Each individually calibrated, direct-reading dial has 100 dial divisions. **Engineering Department, Hunter Spring Company, CE 7-112, Lansdale, Pa.**

Safety Coating

A NEW SKIDPROOF COATING for industrial floorings, called Sono-Grip, which is brushed on like paint, gives a nonslip finish to wood and concrete floors, steel treads and metal decks. It can effectively be used to resurface worn steel matting at a much lower cost than the replacement of the matting would make necessary. It is resistant to gasoline, alcohol, oil, grease and many types of acid and provides nonslip protection whether the surface is dry, wet or oily. One or two coats of Sono-Grip will cover any properly prepared surface, and it has unusual elasticity and bonding characteristics, adhering well to smooth surfaces, including steel. The finish is available in red, green, yellow and gray. **Building Products Division, L. Sonneborn Sons, Inc., CE 7-112, 404 Fourth Ave., New York 16, N. Y.**

Model 391 Hot Rod

EQUIPMENT MATERIALS and METHODS

(continued)

Tandem Axle Six Wheel Trucks

A COMPLETELY NEW LINE of tandem axle six wheel trucks ranging from 31,000 to 46,000-lb maximum gross vehicle weight and up to 65,000-lb maximum gross combination weight and powered by new V-8 engines ranging up to 220 hp, is being introduced.

Because of the increasing demand for six wheelers for over the road hauling, off highway uses, dump trucks, concrete mixers, highway construction and other uses, the new Dodge trucks are offered in a wide range of power, wheelbases and capacities.

The new KX model is powered by a 201 hp V-8 engine with 331-cu in. displacement. Offered in wheel bases of 141, 153, 171 and 189-in., it has a maximum gross vehicle weight rating of 31,000-lb and a maximum gross combination weight rating of 45,000-lb. The rear axle bogie capacity is 22,000 lb, with 28,000-lb offered as extra equipment.

The new TX model is powered by a 212 hp V-8 engine. This 331-cu in. displacement engine has twin carburetion. Offered in wheelbases of 144, 156, 174 and 192-in., it has a maximum gross vehicle weight rating of 36,000-lb and a maximum gross combination weight rating of 55,000-lb. The rear axle bogie capacity is 28,000-lb.

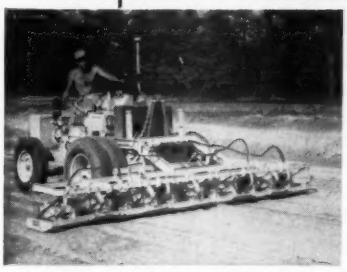
Powered by a 220 hp V-8 engine with 354-cu in. displacement, the new YX model is offered in wheelbases of 144, 156, 174 and 192-in. It has a maximum gross vehicle weight rating of 46,000-lb and a maximum gross combination weight rating of 65,000-lb. The rear axle bogie capacity is 34,000-lb, with 38,000-lb offered as extra equipment.

All of the new truck tandem models are lighter in weight to provide greater payload capacities and increased profits in hauling operations. They were designed for maximum flexibility and traction in rough off highway operations, with 5-speed transmissions as standard equipment. **Dodge CE 7-113, Detroit 31, Mich.**

Here's TREMENDOUS COMPACTION

. . . for rapidly and most economically achieving or exceeding specified densities in the consolidation of rock, slag, gravel and sand base courses in waterbound and penetration macadam construction. The Jackson does it in just about half the time required with equipment of other types and is equally efficient in filling all the voids from top to bottom of rock and slag courses when sufficient fines have been spread.

Exceptional ON-THE-JOB ADAPTABILITY!



Above: a Jackson Multiple (6 units) on 7 mile sub-grade. Below: 2 units equipped with operating handle, self-propelling and easily operated by one man.

Standard width of the Jackson Multiple is 13', 3"; working speeds: up to 60' per minute; reverse: up to 5 MPH. Working width can readily be altered on the job to exactly suit narrower requirements such as widening projects. As many of the 6 compacting units as desired can be subtracted from the workhead, quickly and easily. Furthermore, easily interchangeable bases from 12" to 26" are available and individual compacting units may be fitted with operating handles and used exactly like the standard, highly popular, self-propelling manually guided Jackson Compactor. As a consequence Jackson equipment can be used on a great deal of work other machines cannot reach. If you have any job requiring compaction of granular soil, it will pay you to know specifically what Jackson Vibratory equipment will do. See your Jackson distributor. Literature and name of nearest Distributor on request.

JACKSON
VIBRATORS, INC.
LUDINGTON, MICH.

SETS THE STAGE FOR FRESH AIR

When the curtain goes up on underground construction, you're all set when Naylor ventilating lines are part of the scenery.

Naylor pipe provides lightweight lines that can be installed faster and easier. What's more, the exclusive Naylor structure permits the use of lighter gauge material to cut your costs without sacrificing performance.

The Naylor one-piece Wedge-Lock coupling is another dependable "prop" that speeds installation of vital air lines. Lines can be assembled with only one side of the pipe in the open and extended rapidly as the work progresses. It's a combination well worth looking into.

Write for Bulletins No. 507 and No. 514.

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Eastern U. S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

EQUIPMENT MATERIALS and METHODS

(continued)

Shovel Crane

THE CRAWLER MOUNTED K-608 is convertible to shovel, crane, dragline, clamshell and piledriver attachment. The machine is designed for 3-yd shovel operation with rated crane lifting capacity of 75 tons at 12-ft radius. It features Speed-o-Matic true power hydraulic control, a fingertip operated, quick response system that is said to offer up to 25 per cent greater output than similar sized machines with manual controls. Hydraulic pressure is produced through a pump driven by the engine. Pressure is metered to the clutches by variable pressure control valves that the operator opens and closes with short, fingertip controlled levers to provide immediate, smooth actuation of all clutches. It also offers power hydraulic actuated steering clutches. Important by products of complete hydraulic control are reduced operator fatigue, increased daily production and less downtime for maintenance.

K-608

Standard power equipment consists of torque converter and engine combination which are matched for greater horsepower output, consequently greater production, during the digging cycles. The converter also provides for closer control and smoother operation in crane work.

Digging brakes are controlled from the cab and serve as both steering and digging brakes. Hydraulically actuated, they have capacity to hold the machine on any workable grade. Spring-loaded and hydraulically released, they are applied automatically when travel jaw clutches are disengaged.

A significant feature for a machine of this size is the K-608's rigid track drive assembly, which is designed to hold the chain sprocket and track drive sprocket in positive alignment at all times. **Link-Belt Speeder Corp., CE 7-114, Cedar Rapids, Iowa.**

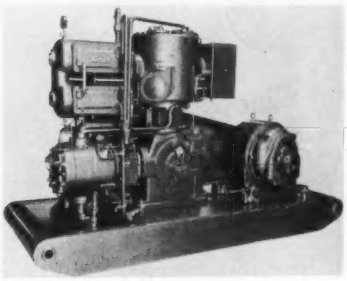
EQUIPMENT MATERIALS and METHODS

(continued)

Skid Mounted Compressor

ALONG WITH THE RECENT ESTABLISHMENT of a specialized compressor sales and service division within its staff, the company's line will be broadened to include the full range of Atlas Copco series AR compressors. Previously, this supplier of Swedish made equipment focused its activities on smaller and portable compressors.

The heavy duty AR Compressor series is especially designed for rugged construction and logging operations, and includes six models, ranging in size from 330 to 3,220 cfm—all of the L-shaped, two stage, double acting type compressor, fully counter-balanced.



AR Compressor

Units to 800 cfm in the series are available steel skid-mounted, requiring no concrete foundation and permitting the compressor plant to be moved to different sites as work progresses.

Relatively low operating speeds are claimed to be the stand out feature of these models. Longer valve life and less operating heat are among the reported accrual advantages, as well as a power requirement to drive, said to be approximetely 5% less than that of comparable size compressors. Standard type synchronous or induction motors may be used as the drive source. Other construction features include annular type valves to permit maximum air passage, and easy-operating double-row spherical roller bearings in the crankshaft journals. **Atlas Copco Pacific Inc., CE 7-115, 930 Brittan Ave., San Carlos, Calif.**

Portable L-P Gas Torches

A NEW LINE OF PORTABLE TORCH BURNERS has been put on the market for use in maintenance, repairing, manufacturing and processing as well as for application to road oil distributor trucks and asphalt, tar, pitch and compound melting kettles.

(*Continued on page 116*)

SONOTUBES®
used to reduce cost of construction of parking garage

Parking Garage, Philadelphia Parking Garage Authority, Phila., Pa.
McClosky and Company, General Contractors.

SONOTUBE®
FIBRE FORMS
for round columns of concrete

This structure contains both 36-inch and 32-inch round concrete columns formed by low-cost SONOTUBES.

SONOTUBE Fibre Forms help reduce the cost of construction for any project because they erect quickly . . . only minimum bracing is required . . . they handle easily . . . they can be sawed to your requirements on the job . . . and SONOTUBES are low in cost!

You save money on formwork and time and labor, too, when you use SONOTUBES to form round columns of concrete!

SONOTUBE Fibre Forms are being used from coast-to-coast in the construction of parking garages as well as for piles, piers, underpinning and columns in a wide variety of structures.

SONOTUBE Fibre Forms are available from 2" to 36" I.D. up to 50' long. Order in specified lengths if you desire.

Use Sonoco's patented "A-Coated" SONOTUBES for finished columns; wax-coated also available.

Use SONOTUBES on your next job and save time, labor and money!

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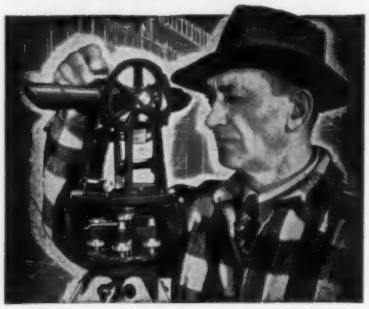
The man behind the gun will tell you...

WHITE GIVES YOU

greater, longer-lasting precision...



Shown, model 7014 with "A" standard. Model 7014 same unit with "U" standard, also available.

yet costs less than other quality engineers' transits

LIKE every White quality-built instrument, these engineers' transits give you greater dollar-for-dollar value than any other comparable unit.

For example: White uses a recently-developed Swiss Dividing Engine to cut graduations into solid silver. This insures super-precision from the beginning, safeguards it through more years of hard field usage.

In addition, White engineers' transits give you internal focusing, covered leveling screws and coated optics. These and a host of other design and operating features combine to give you a transit unsurpassed for ease, speed, accuracy, economy and long-lived dependability. Write for Bulletin 756 and the name of your nearest dealer. DAVID WHITE COMPANY, 309 W. Court Street, Milwaukee 12, Wisconsin.

DAVID WHITE COMPANY

We offer expert REPAIR SERVICE on all makes, all types of instruments

EQUIPMENT MATERIALS and METHODS

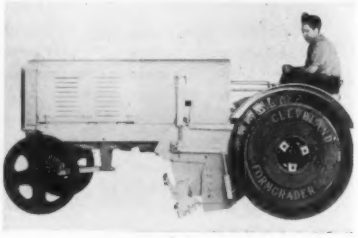
(continued)

These torches burn liquefied petroleum, butane or propane, commonly known as bottled gas, at 5 to 30-lb pressure. They are light in weight, yet rugged, light instantly without preheating, burn steadily and deliver powerful smokeless heat with a fully regulatable flame and require little attention.

Supplied in three sizes with a fuel consumption of 145,000, 400,000 and 500,000 btu per hr maximum, they are made with straight handles for general maintenance and manufacturing work. For melting kettles, they are made with an angle type handle, a suspension handle or with a leg and tongue to fit any kettle design. For distributor trucks, the torch is easily attached at the rear end of the tank to fire into the heater tubes. **Hauck Mfg. Co., CE 7-115,116, 124-136 Tenth St., Brooklyn 15, N. Y.**

Formgrader

AN IMPROVED FORMGRADER INCORPORATES full power steering and hydraulically operated cutter lift bar and an improved self starter. These improvements enable one operator to quickly and easily cut accurate form trenches at a constant depth for road construction. Stakes are set up with a guide line at the required height and the operator simply sees that the line guage on the left side of the machine follows the guide line running between the stakes. As the line guage on the machine is always kept level through



Improved Trench Cutter

means of a pendulum controlled shaft, the form trench is always cut to the proper depth regardless of the unevenness of the ground.

Of sturdy construction throughout, the machine uses a heavily weighted drive wheel which follows in the path of the cutter blade and simultaneously compacts and rolls the trench ready for instant setting of forms. It is also available with a crawler track drive. **Cleveland Formgrader Co., CE 7-116, Mills Road, Avon Ohio.**

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Structural Steel
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EQUIPMENT MATERIALS and METHODS

(continued)

Wire Rope Clips

DESIGNATED ACCO WIRE ROPE CLIPS, these assemblies are drop-forged from high grade forging steel and are said to provide positive grips of steel for tough, heavy-duty service.

Engineered for safety, the base channel is shaped to hold the wire rope securely without damage to individual strands. They can be applied on the job and no vise or other special tools are required. The U-bolts, made of heavy steel, are protected against the formation of rust and corrosion

Engineered for Safety

by hot-dip galvanizing after threading. Threads are exceptionally free running because no point is used. Further protection is added by a green chromate coating which is applied after the galvanizing. Bases of the assemblies are also hot galvanized as are the Standard American hex nuts.

These clips are manufactured to secure wire ropes of $\frac{1}{8}$ in. to $1\frac{1}{4}$-in. diameters and are pre-packaged in lots of 10 to 100, according to size. **American Chain & Cable Co., Inc., CE 7-117, 929 Connecticut Ave., Bridgeport 2, Conn.**

Concrete Finisher

A NEW MODEL 4-BLADE CONCRETE FINISHER featuring adjustable pitch blades is announced. This adjustability of blade pitch during the finishing compensates for all the various surface conditions encountered; it eliminates blade changing and speeds up finishing. Unlike the 3-legged stool, this 4-blade finisher does not adapt itself to uneven surfaces, thus it works down the high spots and gives a truer level finish faster. Controls on the handle are easily operated. **Superior Cement Tool Co., CE 7-117, 11616 Wright Road, Lynwood, Calif.**

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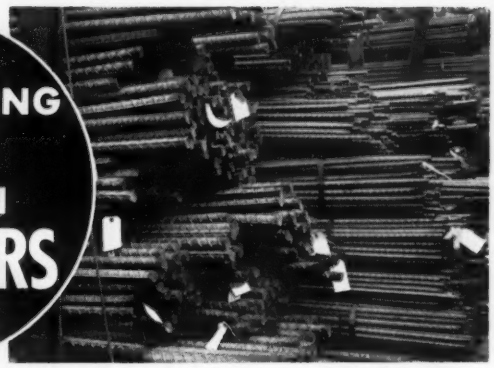

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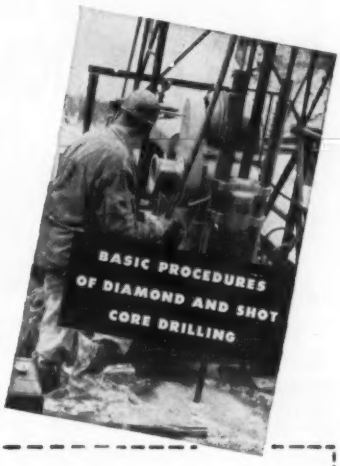

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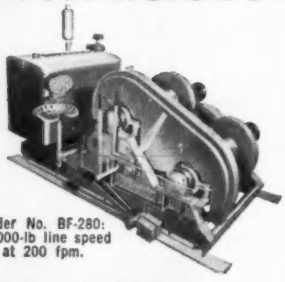

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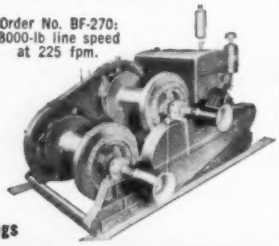

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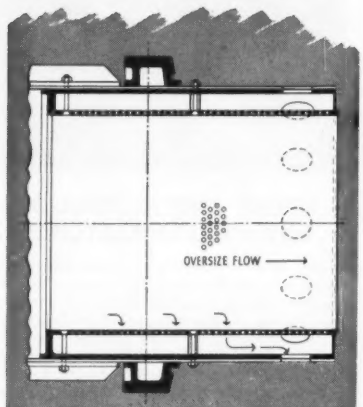
Here's Way To Increase Your Screen Capacity 25%



This Yuba-built Olson trommel mounts in new or old screens, converts usually blanked out space into productive screening area without lengthening screen.

Your screen capacity actually can be increased as much as 25%—without adding to the screen length—by mounting Yuba-built Olson trommels inside your present screens.

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For your present screens or for new ones, Olson trommels, made of abrasion resisting steel plate to fit your needs, can be either field or factory installed. Send details and general arrangement of your screen, hole sizes and spacing needed. Estimates furnished promptly; no obligation.

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EQUIPMENT MATERIALS and METHODS

(continued)

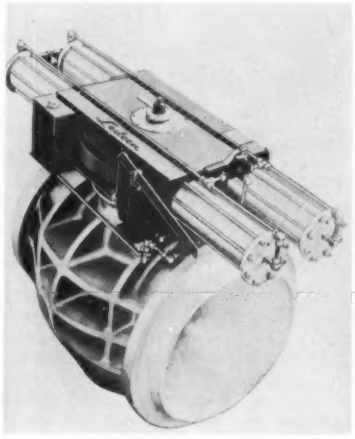
Dial Saw

A NEW INDUSTRIAL WOOD and metal working tool for use with heavy duty equipment, the Model 500 Dial Saw uses the same principle of dial setting for accurate size as its forerunners, models 250, 375 and 400. It cuts perfect holes quickly and accurately any size from $2^1/_4$ to 5-in. in diameter. Made from high alloy steel, with satin like black rust resistant finish, with easy to read calibrations permanently engraved, a turn of the calibrated dial immediately sets the high speed steel cutter blades to the diameter desired.

Available in three shank types, Model 500 with $^1/_2$-in. straight shank, Model 500A with $^3/_4$-in. straight shank, Model 501 with Morse No. 2 Taper shank, each is furnished with $^1/_2$-in. pilot drill and push out plug, which are interchangeable, and two sets of high speed steelcutter blades. **Robertson and Ruth, CE 7-119, Box 534, Elmhurst, Ill.**

Quad Actuators

BUILT TO OPERATE HIGH-PRESSURE PLUG and ball valves up to 36-in. in size a new Actuator has just been introduced. Features claimed for the unit are: balanced torque delivered to valve stem through four-cylinder operation, gas and oil systems entirely separate, no gas-oil interface, for periodic testing, detachable

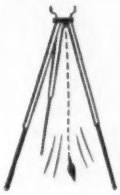


Model 6Q512

lever permits operation of actuator and controls without turning main valve, easy field installation without modification of plug valve, available in wide range of torque capacities, and a variety of control systems. **Ledeen Mfg. Co., CE 7-119, 1600 So. San Pedro St., Los Angeles 15, Calif.**

SURVEYING NEWS

NEW THEODOLITE SETS UP QUICKLY, EVEN IN THE WIND



Has this been your problem? Now—old-type mechanical plumb-bob replaced by can't-miss optical principle

- **Improved Theodolite reads horizontal and vertical circles simultaneously, through same eyepiece**
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- **Amazingly blur-free—small, compact, moisture-proof, dust-proof.**

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EQUIPMENT MATERIALS and METHODS

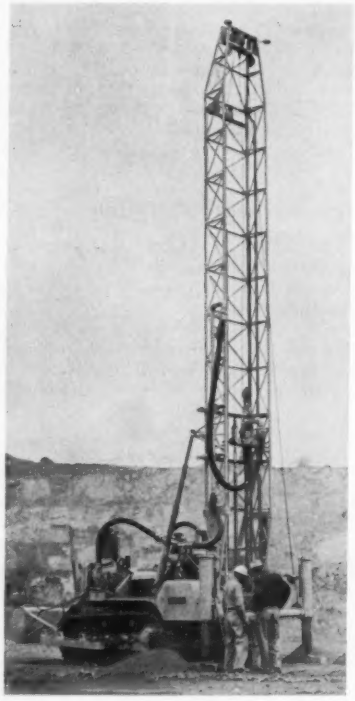
(continued)

Rotary Drill

KNOWN AS THE MODEL 6TA, a new heavy duty rotary drill for vertical blast holes in mining, quarrying and construction operations has been field tested over a two year period with outstanding results according to company engineers.

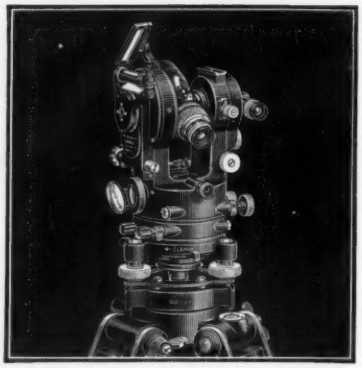
Mounted on a Caterpillar D6 Diesel prime mover, the drill utilizes compressed air for cuttings removal. Two rotary compressors, operating singly or together provide a maximum of 85 psi air pressure with normal drilling pressures of 15 psi.

Up to 27,000-lb weight can be applied on the bit, and using standard oil field roller cone rock bits, the drill averages a foot or more a minute of 9-in. hole in most formations.



Model 67A

The drill is completely unitized with no auxiliary equipment needed. All power is supplied by the tractor engine through a heavy duty transfer case. Controls are located at the rear of the drill where the operator has full view of drilling operations. Dust control and cuttings collector systems are provided as the job requires. Two men operate the rig with complete efficiency although one man can complete shallow holes alone. **The Winter-Weiss Co., CE 7-120, 2201 Blake St., Denver 5, Colo.**



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LITERATURE AVAILABLE

HOT-MIX ASPHALT PAVING—A new 168-page pocket-size manual containing authoritative information and instruction for the design of mixes by the Marshall, Hveem, Hubbard-Field and Smith Triaxial test methods. Test procedure and interpretation of test data are provided for each mix design method. Appendices include information on the gradation analysis of aggregates and the density and voids analysis of compacted paving mixtures. Price $1.00. **The Asphalt Institute, CE 7-121, College Park, Md.**

PUMP PACKAGING PLAN—Easy stocking, storing, ordering and application are the mutiple benefits of a new, end-suction pump packaging plan described in Bulletin No. B2319. From over 50 different face-mount and close-coupled pump sizes available, surveys by company sales engineers indicated that 22 pump models, ranging from 1 to 15 hp, are the most popularly and regularly ordered sizes. These 22 job-sized pumps are now pre-packaged in reinforced cartons for easy stacking and storing under their Redi-pak Fluidyne label. The bulletin contains complete pump descriptions and an easy to order from selection chart, includes head-capacity performance curves for each of the 22 pumps and stresses the quick availability of these pumps. **Peerless Pump Division, Food Machinery and Chemical Corp., CE 7-121, 301 West Ave. 26, Los Angeles 31, Calif.**

GRANITE—A bulletin entitled "Standardized Granite Highway Products" gives up-to-date information on Fletcher granite highway products. The ready acceptance of granite for highway purposes and the gratifying record it has established emphasizes its superiority through the following advantages: granite products do not readily wear out; their life and beauty may be additionally prolonged through reuse; are practically indestructible in withstanding the actions of abrasion, freezing and thawing, and the impact of heavy equipment and granite curbs contribute to highway safety by reflecting light and defining highway boundaries. **H. E. Fletcher Co., CE 7-121, West Chelmsford, Mass.**

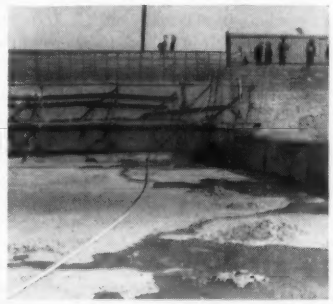
MECHANICAL JOINT—A new folder describes the Amvit jointed vitrified clay pipe, sizes 4-in. through 24-in. A true built-in mechanical joint ready for immediate, quick and easy installation, Amvit is infiltration and root-proof, permits immediate backfilling and testing, offers better flow and less maintenance, permits deflection and absorbs shocks. The joint is furnished on all standard fittings as well as pipe permitting a bottle tight line. **American Vitrified Products Co., CE 7-121, National City Bank Building, Cleveland, Ohio.**

How a seismic survey solved two school site problems in one day

In planning a 340-pupil elementary school on a 13-acre site at Holden, Mass., the School Building Committee had to know two things, quickly. First, was there enough overburden on the site to fill and reclaim an existing swamp? Second, would bedrock be encountered within the 30-foot depth required for grading operations? The presence of many boulders in this glacial till area complicated any boring program. On May 9, 1955 a Gahagan Seismic Survey Crew started work. On that one day, using portable equipment, they completed 1,320 linear feet of subsurface profile. Gahagan's report showed that enough overburden did exist to fill the swamp, and that bedrock would not be encountered down to minus 30 feet. Subsequent actual excavation confirmed these findings. For the full story about seismic surveys, write on your letterhead for Bulletin 2 to Geophysical Survey Division, Gahagan Dredging Corporation, 90 Broad St., New York 4, N. Y.

ANOTHER
GAHAGAN
CASE HISTORY

"GUNITE" ENLARGES AND IMPROVES RESERVOIR



Recently we "GUNITED" the West End Reservoir at Hagerstown, Maryland. The pictures clearly show important stages in our work to give it greater capacity and to stop excessive leakage. After existing cracks in the concrete floor were sealed, "GUNITE" was applied to waterproof and reinforce the stone masonry and to add 30 inches to the height of the walls.

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From the MANUFACTURERS

NEW EQUIPMENT PURCHASE: a fleet of 45 new White 9000's powered by 175 hp Cummins JT-6B Turbodiesel, together with 70 trailers, was announced by Costal Tank Lines. . . **HYDRAULIC TURBINE CONTRACTS:** S. Morgan Smith announces the receipt of two contracts with a total value of nearly $5,500,000. Two 180-in. six-bladed Smith-Kaplan turbines have been ordered by the Montana Power Company and three turbines rated at 14,300 hp., by the U.S. Army Corp. of Engineers, Walla Walla. . . **PORCELAIN ENAMELED PANELS:** used for the first time in New York City building, these panels, manufactured and installed by Architectural Porcelain Fabricators, Inc., besides being colorful, are unique in that the steel panels are applied directly to horizontal steel angle irons, top and bottom, with no masonry or brick backing. . . **NEW DISTRIBUTORS:** The Garrett Supply Company announces an extension of its services in the heavy power transmission by becoming an authorized distributor for Chain Belt Company products. . . **NEW SERVICE:** home builders are being shown the advantages of clear-span wood roof trusses in residential construction, and given step-by-step details in trussed rafter fabrication and handling in a new service launched by Timber Engineering Company. . . **HUGE BUILDING PROJECT:** Charles Bruning Company, Inc., plans to build one of the world's largest plants manufacturing diazotype reproduction equipment and materials in a Chicago suburb. Estimated cost of land and building is approximately $3,000,000. . . **SPECIAL MEETING:** a luncheon meeting of thirteen divisions of H. K. Porter Company, Inc., sponsored by Connors Steel Division, was attended by over two hundred leaders of industry, finance and government. High light of the meeting was the showing of a new film briefly outlining the story of the Porter organization. . . **HYDRAULIC CRANE:** Jones & Laughlin estimate that with the use of the new Austin-Western self-propelled hydraulic crane with a retractable boom and its great mobility, they have saved nearly $132,000 a year on the cost of over-hauling each of eleven furnaces. . . **TUBELESS TIRES:** Caterpillar Tractor Company has announced that tubeless tires have become standard equipment on all their No. 40 and No. 60 Scrapers. . . **ELECTIONS:** Carl R. Rolf has been elected executive vice-president of Pioneer Engineering Works, Inc. Mr. Rolf has served his company for more than 25 years. . . Ralph A. Reynolds, assistant treasurer of the Thew Shovel Company, Lorain, Ohio, has been elected Chairman of the National Construction Machinery Credit Group for 1956. Membership in this group includes over 50 leading firms in the construction machinery manufacturing business... **APPOINTMENT:** Lewis C. Black will become sales manager of large machines for Bucyrus-Erie Company, effective July 1.

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990. **Arch Dams: Portuguese Experience with Overflow Arch Dams, by A. C. Xerez.** (PO) An important part of every dam, affecting both safety and cost, is the arrangement by which flood waters bypass the dam. This paper cites Portuguese experience with arch dam spillways.

991. **Arch Dams: Theory, Methods, and Details of Joint Grouting, by A. W. Simonds.** (PO) This paper deals with the problems involved in the contraction joint grouting of arch dams. After briefly reviewing the history of joint grouting as practiced by the Bureau of Reclamation, the present-day practice is presented. An outline of the theory and procedure of contraction joint grouting is included.

992. **Arch Dams: Santa Giustina Single-Curvature Arch Dam, by C. Marcello.** (PO) The design and contruction of an arch dam 152 meters high and located in an extremely narrow gorge is outlined. Briefly discussed is the structural analysis of the dam as confirmed by the model, the construction plant, and the extensive foundation consolidation and cut-off grouting.

993. **Arch Dams: Measurements and Studies on Santa Giustina Dam, by C. Marcello.** (PO) Because of the unusual proportions of this dam, special plans were made to study its behavior resulting from variations of water level and temperature. This paper is a preliminary report; it compares data obtained by four years of observation with data obtained by analysis.

994. **Arch Dams: The Reno Di Lei Double-Curvature Arch Dam, by C. Marcello.** (PO) The design of an arch dam by the trial-load method is presented. The center lines of the horizontal arches are shaped to coincide approximately with the funicular curves of the arch loads. Design is not yet complete and will be verified by model studies.

995. **Arch Dams: Isolato Double-Curvature Arch Dam, by C. Marcello.** (PO) The theoretical analysis, structural model testing, and construction plant of an unusual Italian arch dam are discussed. Data on the actual behavior of the dam for its two years of operation are included.

996. **Arch Dams: Rio Freddo Dam with Gravity Abutments and Cut-offs, by C. Marcello.** (PO) This paper outlines the design and construction of a double-curvature arch dam with gravity abutments and lateral cut-off wings. The instrumentation for determining the actual behavior of the dam is described.

997. **Arch Dams: Design and Observation of Arch Dams in Portugal, by M. Rocha, J. L. Serafim, and A. F. da Silveira.** (PO) Data are presented on design model testing and field observation of six arch dams ranging in height from 60 to 135 meters. These data have enabled later designs to be modified to gain increased economy with safety.

998. **The Federal Air Pollution Research Program, by A. C. Stern.** (SA) The United States Public Health Service has been charged with the control of more than one-half million dollars for air pollution research during the present fiscal year. These funds are to be expended to nonfederal research agencies according to their potential contributions to this problem.

999. **A New Approach to Trickling Filter Design, by W. T. Ingram.** (SA) A new approach to trickling filter design has been made, based on a laboratory investigation over the period of a year. It has been possible to treat domestic sewage successfully at the same hydraulic rates used for rapid sand filtration of water.

1000. **Waste Disposal as Related to Site Selection, by A. E. Gorman.** (SA) The rapid increase in the atomic energy industry has produced many problems with regard to site selection. The paper discusses the waste disposal problems at various AEC installations and efforts made for their solution.

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1002. **Use of Soil Lysimeters in Waste Water Reclamation Studies, by G. T. Orlob and R. G. Butler.** (SA) Current interest in waste water reclamation by surface spreading has dictated a need for further study of the mechanism of infiltration, the phenomena which determine the rates of water percolation, and the interaction of porous media and degraded waters.

1003. **Discussion of Proceedings Papers 590, 773, 847, 885, 892.** (SA) A. C.

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1004. Visual Accumulation Tube for Size Analysis of Sands, by B. C. Colby and R. P. Christensen. (HY) A simple method is presented for analyzing sediments of sand sizes to obtain an accurate determination of fall-velocity distribution. Direct visual tracking of sediment accumulation produces a permanent continuous trace on a calibrated chart.

1005. Free-Surface Disturbances Along a Channel Wall, by A. M. Amein and M. S. Priest. (HY) An experimental study was made of the initiation and growth of free-surface disturbances along the wall of a steep channel. Results from analyses of experimental data are shown in both graphical and mathematical form.

1006. Transition Profiles in Non-Uniform Channels, by F. F. Escoffier. (HY) The concept of a transition profile as a theoretical tool for the study of water-surface profiles, particularly where these pass through critical depth without abrupt change, is developed. A practical method of constructing a transition profile graphically is outlined.

1007. Friction Measurements in Apalachia Tunnel, by R. A. Elder. (HY) This paper presents the results of tunnel friction measurements made on the TVA Apalachia power tunnel in 1944, five months after the initial filling, and again in 1954, five months after the first unwatering.

1008. The Use of Statistics in Reservoir Operations, by V. A. Koelzer. (HY) The development of annual operating plans for reservoir systems deriving their primary water supply from snowmelt, as well as progressive seasonal modifications to these plans, is demonstrated, with particular emphasis placed on the important part that probability analyses play in determining limits for the development of the operational plans.

1009. Free Outlets and Self-Priming Action of Culverts, by W. H. Li and C. C. Patterson. (HY) Data on the effective position of the hydraulic grade-line at the free outlet of full-flowing culverts are presented. Data on the conditions for self-priming of culverts with a sharp-cornered entrance are presented.

1010. Discussion of Proceedings Papers 678, 791, 836, 838. (HY) J. C. Stevens closure to 678. W. Rand closure to 791. J. A. Robertson on 836. R. Silvester, A. S. Harrison on 838.

1011. Discussion of Proceedings Papers 739, 741. (PO) G. Norwood on 739. D. J. Bleifuss closure to 741.

1012. Engineering Job Opportunities in World Health, by H. Engler. (SA) One of the major opportunities facing the sanitary engineer lies in environmental sanitation problems outside the United States. A general discussion of some of the cooperative programs is given.

1013. Advances in Sewerage in the Period from October 1, 1954, to December 1, 1955: Progress Report of the Committee of the Sanitary Engineering Division on Sewerage and Sewage Treatment. (SA) The recent advances in the design and construction of sewers and sewage pump stations are outlined and discussed.

1014. Investigation of Planned Refuse Collection and Disposal: SED Research Report No. 7, Sanitary Engineering Research Committee, Rubbish and Garbage Section. (SA) The results of seven years of investigation to develop a planned refuse disposal program for the Los Angeles County Sanitation Districts are summarized and critically evaluated.

1015. Proportional Weirs for Sedimentation Tanks, by J. C. Stevens. (HY) For grit channels or other types of sedimentation tanks it is desirable to control automatically the mean velocity through the tanks in order to obtain the most favorable conditions for settlement of the solids contained in the influent. This can be done by installing a properly formed weir in the outlet end of the tank.

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1017. Arch Dams: Development in Italy, by C. Semenza. (PO) The reasons for extensive development of arch dams in Italy are listed and the historical stages of that development are traced. The methods of analysis are briefly reviewed and special features of construction procedure are given. The benefits of the peripheral point, which has been successfully used by the author, are explained.

1018. Arch Dams: Design of the Kamishiiba Arch Dam, by C. C. Bonin and H. W. Stuber. (PO) The first arch dam in the Far East, the Kamishiiba Dam, was dedicated in 1955 as part of the 90,000-kilowatt-capacity Kamishiiba Hydroelectric Development. This paper describes terrain, hydrologic conditions, foundation material, design assumptions, and methods of analysis pertaining to this project.

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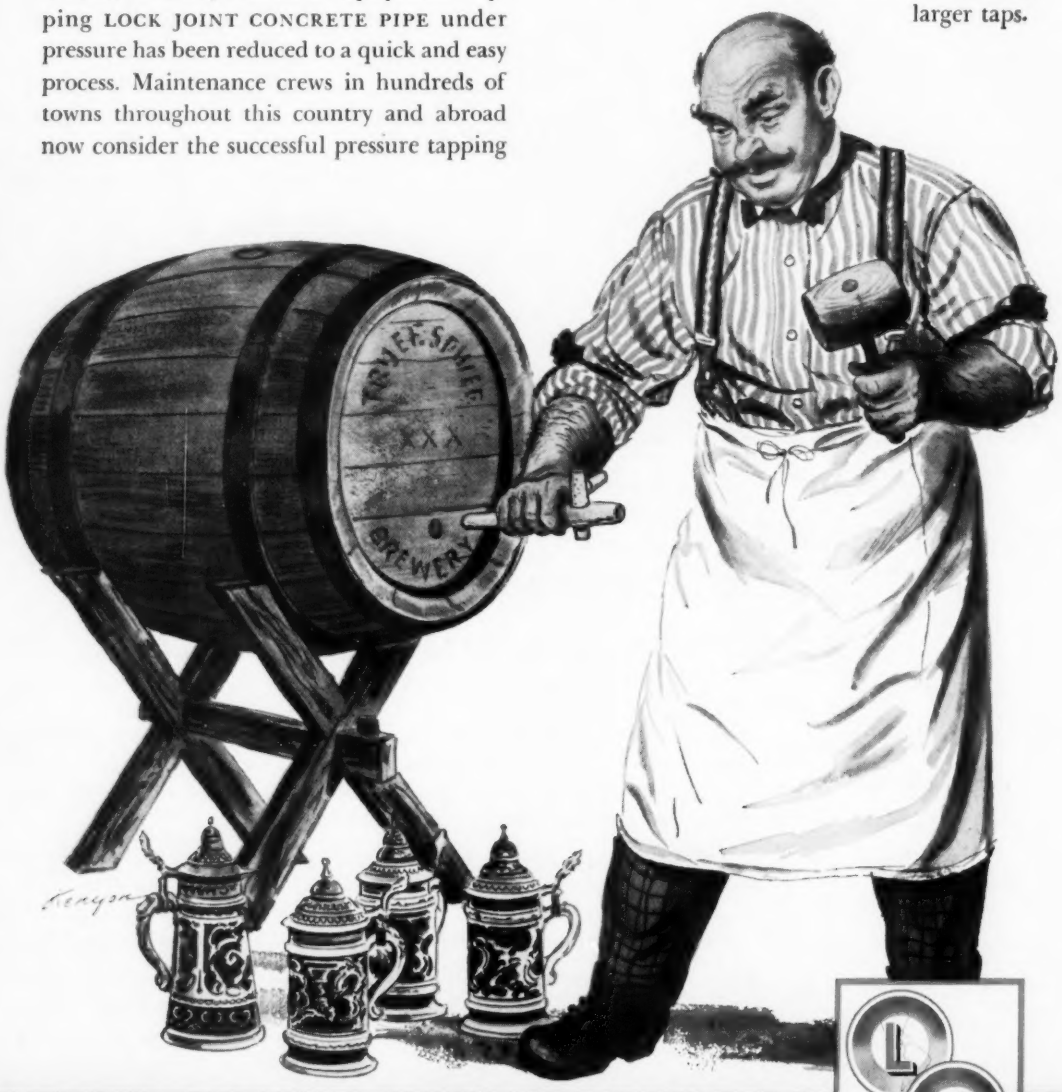

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